The FOUNDRY

Volume 48. No. 1
Whole No. 338

Published
Semimonthly

CLEVELAND, OHIO, JANUARY 1, 1920

Permanent Employment is Assured

Novel Labor Policy, Patterned on Community Lines But More Free in Its Interpretation Forms Important Factor in Developing a Large Steel Foundry

BY PAT DWYER

SINCE the first commercial application of the bessemer converter and the open-hearth furnace in the early sixties, the production of rolled steel products has been confined mainly to a few large centers. Steel mills have served as the generating force developing large communities. In times of financial uncertainty, unemployment has struck hardest in the large cities and the industrial armies in the steel mills many times have experienced the rigors of enforced idleness. The steel casting industry has differed widely from its related steel mill activities. Growing from the same genesis, steel foundries in many instances have clustered in the steel or iron producing centers in order to draw from large labor sources found there. However, accessibility to materials and to markets has brought about a wider distribution and the construction of many steel foundries in smaller communities. From one of these which is typical of a most interesting class may be drawn some valuable pointers on attacking the problem of unemployment. The National Car Coupler Co., Attica, Ind., operates a steel foundry which in 1918 reached a peak production with 15,500 tons. The same company operates the Harrison Steel Castings Co., Murphysboro, Ill., where 300 men are employed in a plant having a capacity of 1000 tons per month. These plants are both located in comparatively small communities. They have no large labor supply from which to draw, and yet they have had all the men needed to meet peak production during the war. During the period following the armistice, although most steel foundries were slack of work, still the National Car Coupler Co. has kept its force together and given employment to a number of men from the Murphysboro plant as well. J. W. Harrison, the founder and president of the company, is a practical foundryman and first operated a plant at Converse, Ind. When the supply of natural gas became exhausted at that place he built the plant at Attica. Several factors influenced him in his choice of a location for this plant and not the least of these was his belief that he would get better results by breaking in and training his own men to work according to his methods than he could by depending upon the more or less floating foundry labor of the larger cities. He instituted the policy of the square deal which assured every man increased pay and promotion according to his merits. This policy has borne fruit as is evidenced by the growth of the plant and a production that has increased

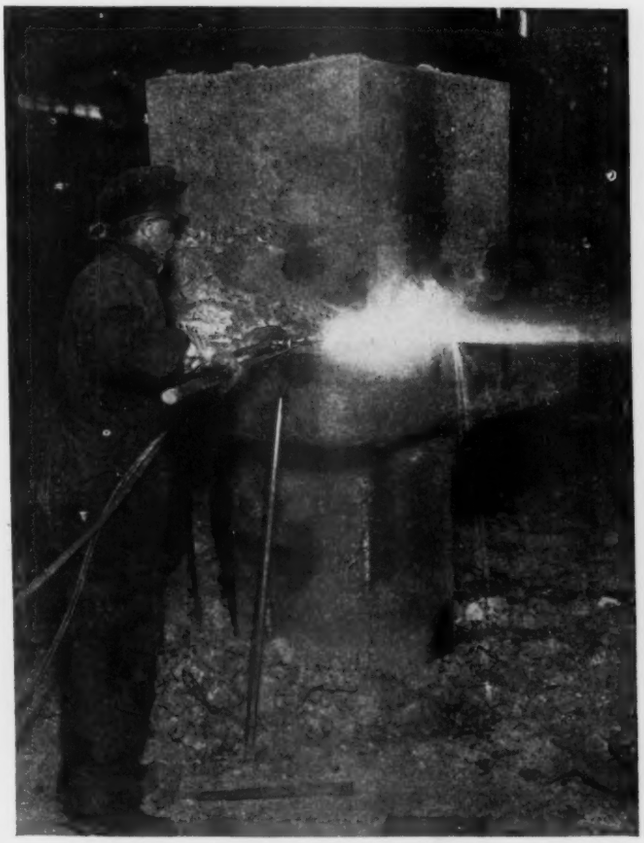


FIG. 1—CUTTING OFF A 48-INCH RISER FROM AN ANVIL BLOCK

FIG. 2—GENERAL VIEW OF THE MAIN BAY, LOOKING NORTH—TWO OF THE HOMEMADE CHARGING PANS AS WELL AS THE SAND MIXERS DISASSEMBLED ARE SHOWN IN THE FOREGROUND

from 1000 tons in 1909 to 15,500 tons in 1918. When improvements now in hand are completed the company will have an annual capacity of 36,000 tons. The number of employes has been increased from year to year but with little labor shift, as some of the older men have been with the company since its inception and the average time a man has served with the company is long.

Promotion at the National company is all from within. The foremen, superintendents and melters, with the exception of the chief melter who was brought in when the company started operations, all were trained and developed on the premises. The general superintendent, William Kirkman, entered the foundry as an apprentice at the age of 13. Furthermore every employe is a white man and has American citizenship. Another rather unique feature which makes for a successful and contented organization is the fact that when business slows down, as it does occasionally in all foundries, the men are not laid off nor are their salaries reduced. Advantage is taken of these slack spells to carry out improvements in plant and equipment. Some of the foremen return to the floor as molders, the molders who are not needed are set at concreting, carpentry and structural iron work. The melters from idle furnaces are placed as first and second helpers on the remaining furnace if one remains in operation and all the other labor set at miscellaneous work around the yard and buildings. These men are paid their former rate at the new work to which they are assigned and when business resumes they all are placed back in their former positions. Thus the company has a complete organization on hand at all times, ready at a minute's notice to operate the plant to its full capacity.

The employes maintain their own sickness and death benefit association, as well as a safety first and accident prevention organization. These are conducted in the same manner as those in the largest and most representative plants in the country, officers and committees being chosen from among the workmen.

The company has equipped a room in the general office with every appliance necessary to serve as a first aid station in case of injury or accident to any of the employes. However, owing to the relatively high standard of intelligence obtaining among the men employed, and the untiring activity of the accident prevention committee, no serious accident yet has occurred at this plant.

A brass band of 40 pieces presided

FIG. 3—IN THE LEFT FOREGROUND ARE SOME OF THE FRAMES USED FOR STACKING SNAP FLASKS READY FOR POURING

over by a co[illegible]tent paid bandmaster is another ev[illegible]ce of the company's interest in t[illegible]e men's well being, recreation and comfort. A huge band wagon is ready at all times to carry the company band to any of the surrounding towns where their presence may be required.

While in a general way the building and equipment are similar to other open-hearth steel casting plants still there are many points in the shop practice as well as in the labor policy in force, which make this small-town foundry of peculiar interest. The plant is situated on a large plot of land which allows for future expansion. Direct rail communication is maintained with Chicago, Detroit and St. Louis over the Wabash railroad and the Chicago & Eastern Illinois railroad.

The group of buildings comprising the plant includes a foundry building, 190 x 580 feet, a cleaning room, 140 x 300 feet, a three-story pattern shop and storage, 80 x 360 feet, and a boiler room, power house and general office building, 40 x 225 feet.

The foundry is divided longitudinally into four bays, one 56 feet, two 36 feet and one 28 feet wide. The melting equipment includes two 20-ton and one 15-ton acid lined open-hearth furnaces. These are situated on the east side and near the center of the shop. They are charged mechanically by a Wellman-Seaver-Morgan 5-ton charging machine. The furnace doors are raised and lowered by air hoists. A short track, with suitable turntable crosses the charging track at right angles at each end of the charging platform extending into the foundry at one end and into the scrap yard at the other. The charging pans are solid one-piece steel castings made by the company's own foundry. It is claimed that they give better satisfaction than the plate pans with cast steel ends which generally are used. They are placed on the floor in the foundry, the cleaning room or in the yard where they are filled with the necessary materials then hoisted to a waiting narrow gage car on the charging platform. From here they are pushed by laborers on to the turntable and thence to the track paralleling the furnaces. Oil is used for melting. It is stored in tanks having a total capacity of 75,000 gallons, which are situated across the tracks east of the furnaces.

A 15-ton locomotive crane, made by the Link Belt Co., Chicago, shunts the cars in the yard, unloads all bulk material and fills the charging pans. For the latter purpose the crane is equipped with a magnet made by the Cutler-Hammer Manufacturing Co., Milwaukee. Nearly all the remaining space in the bay where the furnaces are located is taken up by the sand bins. The roof is provided with large hatchways and the sand and other material is dropped through them from a grab bucket operated by the locomotive crane. A noticeable feature of this foundry building is that it is arranged in duplicate and practically is equivalent to two foundries. Each part has sand storage bins, sand mixing pans, repair shops for

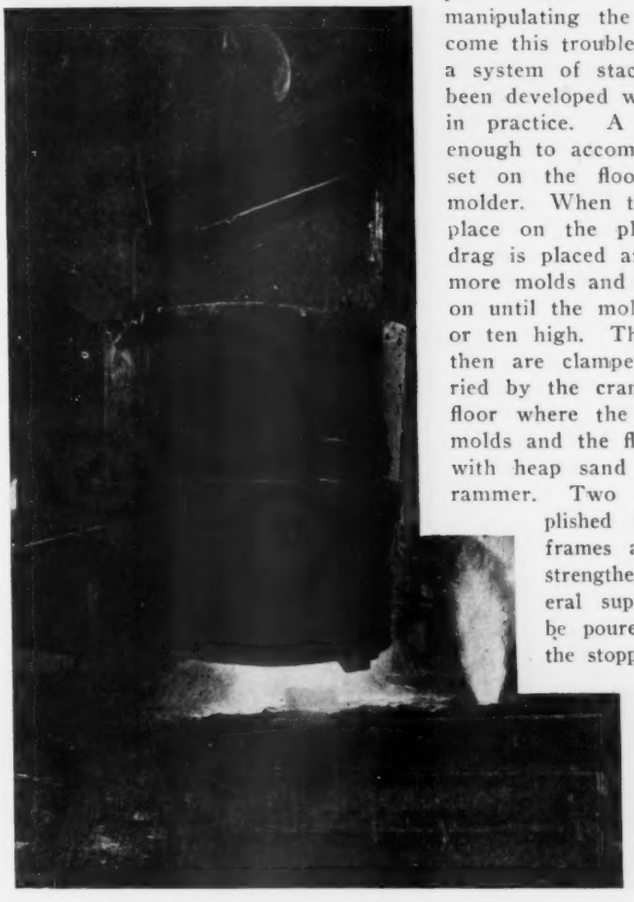


FIG. 4—POURING A HEAT FROM A 20-TON LADLE

wooden flasks used in green sand molding, and core and mold drying ovens.

The main bay of the foundry is served by five cranes supplied by the Cleveland Crane & Engineering Co. They are 30, 25, 15 and two of 10 tons capacity, respectively. In addition there are several jibs swinging from the main roof columns. These cranes are equipped with chain block hoists. There are two 10-ton cranes in the west bay made by Pawling & Harnischfeger, Milwaukee, and one 10-ton crane of the same make operating on a 60-foot runway in the yard. This runway is a continuation of the craneway in the shop and is used for carrying large iron flasks into and out of the foundry. The sand mixing pans used in this shop are larger than those in general use, being 9 feet in diameter. They were developed and built according to plans prepared by the company's foundry superintendent and master mechanic.

Considerable light work is made in this shop in snap flasks, and since all the steel is poured through a bottom nozzle from a 20-ton crane ladle, the amount of time and work involved is readily apparent. This method of pouring light work calls for the highest type of skill on the part of the craneman and the man manipulating the stopper. To overcome this trouble to a certain degree, a system of stacking the molds has been developed which works out well in practice. A bottom plate long enough to accommodate six molds is set on the floor near each bench molder. When the six molds are in place on the plate, a long narrow drag is placed around them then six more molds and another drag and so on until the molds are stacked eight or ten high. The surrounding flasks then are clamped together and carried by the crane over to the main floor where the spaces between the molds and the flask frames are filled with heap sand packed with an air rammer. Two objects are accomplished by this method, the frames act as a curbing and strengthen the molds, and several superimposed molds may be poured at one opening of the stopper. The time of pouring a ladle full of steel varies with the class of work. Sometimes it requires an hour during which over 200 individual molds may be poured and again the total contents of the ladle or even of two ladles may be required to pour a single casting. Large platform pans 10 feet square are used to transport castings, cores and sand from one part of the shop to the other. These are made of ¼-inch steel plate built on a frame of 6-inch I-beams. Six-inch I-beams also form the upper sides and attached to them are rings in which to engage the hooks of the crane chains. The waste and superfluous sand, old cores, runner heads, etc., are loaded into these pans and dumped into one of the 5-ton White auto trucks. These trucks in turn haul the waste material away and dump it to form a fill in a low portion of the plant yard which is gradually being built up to the level of the rest of the property.

Nearly all of the work on the floor, on the bench and in the core room is rammed with Ingersoll-Rand pneumatic rammers. There is one jolt roll-over machine on the main floor manufactured by the Cleveland-Osborne Co., Cleveland, and one plain jolt machine in the coreroom made by the Tabor Mfg. Co., Philadelphia. A special room is set apart in the west bay of the foundry where pneumatic tools are stored, looked after and repaired when necessary. All the rammers are taken to this room at night and after being cleaned are left standing in a bath of oil until morning. Near this room are situated two other rooms which form part of the general scheme of supply, repair and maintenance. The first is a blacksmith shop where the rods used for gaggers, cores and chills are cut off and bent, and the other is a store room where a supply of everything entering into the production of steel castings is kept on hand. An automatic card index is kept in the supply room. Each item is checked off as it is taken out and when the card shows that the stock has been depleted to a certain predetermined point the store clerk orders a further supply.

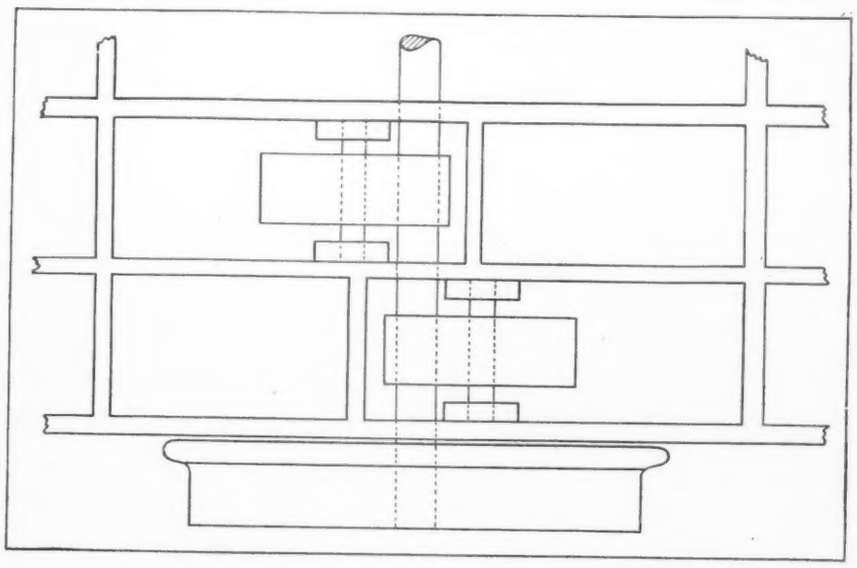


FIG. 5—DETAILS OF ROLLER BEARINGS ON CORE-OVEN CARS

Cover Cores Economical

Cover cores are used extensively in this shop instead of copes. It is claimed that many economies result from their use. It is said that cover cores save time in handling and that by their aid unskilled men can make work which otherwise would require the services of highly skilled molders. One large oven 7 x 14 x 32 feet is devoted altogether to the drying of cover cores. Its construction and general features are typical of the other seven core ovens and four mold-drying ovens in the shop. Two car tracks are provided. The oven is fired with oil. The firing chamber is in the middle of the oven floor and extends the whole length of the oven It is covered by cast steel perforated plates, each 2 feet square by 1 inch thick. An opening in each of the four corners of the floor connects with a flue leading to the chimney. The roof of the oven, instead of being flat or one continuous arch, is made up of many narrow arches. Inverted T-shape beam castings extend from wall to wall at intervals of two feet and brick arches are sprung from these beams to form the roof. The oven cars are of cast-steel open-frame construction, 5 x 6 feet, mounted on four wheels. An original style of roller bearing has been incorporated in their construction. The general features are shown in Fig. 5. As may be seen from the illustration it consists of two small flat tread wheels revolving on axles high up in the frame of the car. These wheels support the car frame upon the axles of the truck. By this arrangement the car instead of resting a dead weight on each of the four truck wheels, becomes a live weight resting on many points and can be moved with a minimum of effect. This is a unique application of the roller-bearing principle.

Method for Loading Cores

The core ovens are provided with doors at each end. Core drying racks are built like tables and may be stacked on top of each other. When built to the desired height the stack of tables is picked up by the crane and set on one of the core-oven cars. By the time several cars have been loaded the cores in the oven are dry. The doors are opened, and front cars pulled out with the crane and the cars containing the green cores run in from the other end of the oven.

Between the foundry and the cleaning room all castings pass through the sandblast department which is provided with six units supplied by the J. W. Paxson Co., Philadelphia. The chipping room is equipped with 30 grinders made by the Safety Emery Wheel Co., Springfield, O.,

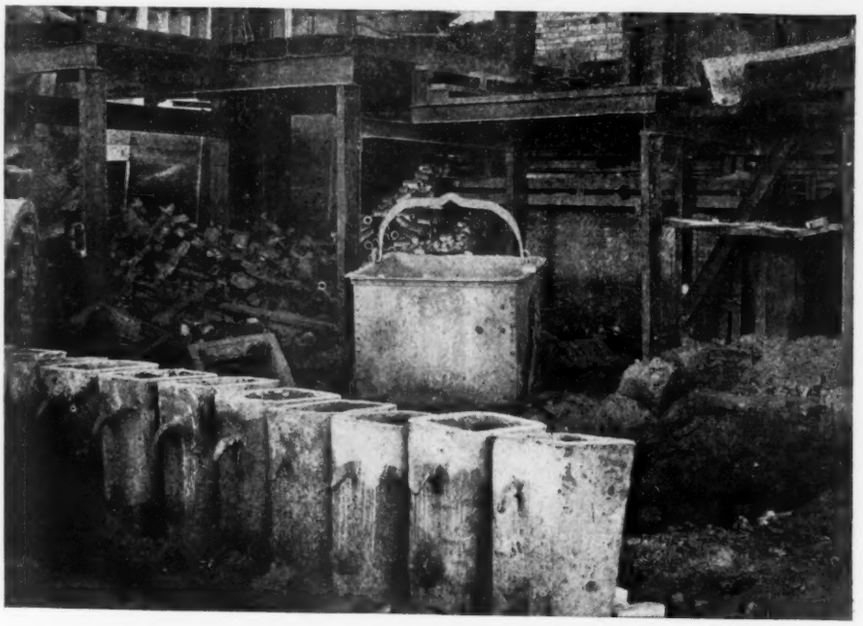


FIG. 6—THE SHORT INVERTED INGOT MOLDS TAKE THE PLACE OF A PIG BED IN AN IRON FOUNDRY

and an equal number of swinging grinders made by the Norton Co., Worcester. The belts on all the machinery in this building, as well as in other parts of the plant are enclosed in safety-first frames.

Two Pawling & Harnischfeger 10-ton cranes, one of which is equipped with a Cutler-Hammer magnet, and two floor trucks made by the Automatic Transportation Co., Buffalo, are used to transfer castings from one part of the building to another. Surface defects or flaws which do not affect the usefulness of the castings are welded by one of the two electric welding installations, made by the Lincoln Electric Co., Cleveland.

Heavy risers are cut from castings by oxyacetylene torches. A number of oxygen tanks are stored in a special compartment and connected to a common pipe leading out into the chipping room. Acetylene is generated near by and also piped to the same place. Suitable connections are provided for attaching the torches to these main pipes and thus a constant supply of gas is assured throughout the day and the trouble and inconvenience of carrying individual tanks from place to place, besides the time lost in making connections is avoided.

Three ovens provide ample annealing facilities. One is a car-type oven and was built specifically for annealing locomotive frames. In the others the castings are simply piled on the floor brought up to 1600 degrees Cent., and allowed to cool after which they are removed. The ovens also are used for heating warped castings which need to be straightened. Oil is used for fuel in all the annealing ovens.

One spur of a main railroad track runs close alongside the building where castings are cleaned. It is depressed sufficiently to bring the floor of the freight cars to the same level as the floor of the building from which castings are shipped. Another spur track enters the building at one end and enables cars to be spotted under the crane when large castings are to be loaded. This facilitates the work of the shipping department.

A battery of six 900-horsepower boilers, three of which are active and three in reserve furnish steam for power and heating. Compressed air is delivered to the plant from one direct steam-driven, high-pressure Ingersoll-Rand compressor having a capacity of 1300 cubic feet per minute and one Bury low-pressure machine having a capacity of 1000 cubic feet of air per minute. Three small Bury compressors with a capacity of 300 feet each are held in reserve. Three generators one of 100 kilowatts and two of 250 kilowatts each furnish all the electric current necessary. These all were made by the General Electric Co., Schnectady, N. Y.

The company maintains a fully equipped laboratory and testing department where a constant check is kept on all melts to see that they measure up to the proper standards. The remainder of the building is taken up by the first aid room previouslly referred to and by the general offices of the company.

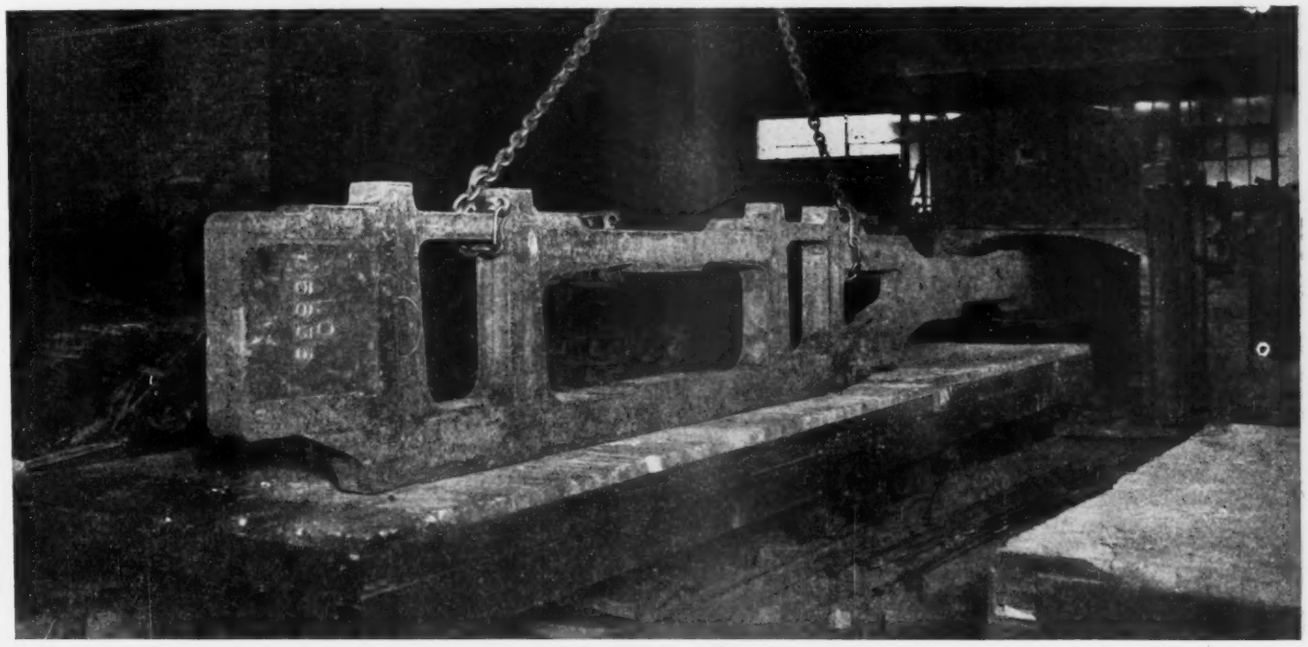


FIG. 7—OWING TO FORESHORTENING THE CASTING APPEARS TOO LARGE TO GO IN THE OVEN. THE OVEN IN THE BACKGROUND, HOWEVER, WAS BUILT EXPRESSLY FOR ANNEALING THESE LOCOMOTIVE SIDE FRAMES

Keeping Dirt Particles Out of Castings

By H. E. Diller

Question—Please tell us what we can do to secure clean castings. We melt with a high grade 72-hour coke and use oyster shells for a flux. Our cupola does not have a slag hole and this makes it necessary to slag the cupola through the tap hole.

Answer—We believe that your melting practice would be helped if you would put a slag hole in your cupola, six or eight inches below the tuyeres. We would also recommend the use of two pounds of fluorspar to a ton of metal. This should be placed on top of each charge after the second, towards the center of the cupola, so that it will not come in contact with the walls of the cupola.

Precautions should be taken against dirt in the iron by using strainer cores. These are perforated discs made of core sand and placed in the runner gate, usually at the bottom. Another safeguard is to place perforated tin plate on top of the runner gate. This has a tendency to hold the metal in the runner box a few seconds until it partially fills the box. The scum and dirt which floats to the top is thus prevented from entering the mold.

The S. F. Bowser Pump & Tank Co., Ft. Wayne, Ind., has purchased the plant of the Menefee Foundry Co. of that city. The Menefee company has made castings for the Bowser company for the past 30 years.

Adapting a Skip Hoist to the Cupola

Borrowing An Idea From Blast Furnace Practise and Fitting it to Meet Foundry Conditions Brings Gratifying Results in Handling the Cupola Charge

INCLINED planes are perhaps the oldest of the seven mechanical devices through which all energy or force may be applied. A familiar example of the inclined plane in olden times is that of its application to building the ancient pyramids of Egypt. Great blocks of stone were hauled long distances on rollers and finally were dragged up an incline and rolled into the place which they since have occupied, and for that matter, the place they probably will occupy until time is no more. A modern application of the principle is seen in the operation of a skip hoist on a blast furnace. The early blast furnaces were small and were charged by hand. They usually were built on the side of a hill to facilitate hoisting the material to the charging platform.

As blast furnaces continued to grow hand charging became entirely inadequate to supply the great quantity of materials charged. Further, convenient hill sides were not always available from which to build a runway out to the furnace top. It was the old case of Mahomet and the mountain. If the ore pile could not come to the furnace, the furnace had to go to the ore pile. The skip hoist made the change possible. All materials for the furnace burden, ore, coke and limestone now are stored in huge bins from whence they are loaded into cars which are pulled up an inclined track to the top of the furnace. Each car as it reaches the top is automatically tripped and the contents dumped upon the charging bell.

A foundry cupola is similar in many ways to a blast furnace and methods which have proved economical and efficacious in the case of one should prove equally so with the other.

The experience of the Bowler Foundry Co., Cleveland, tends to demonstrate that an adaptation of the blast furnace skip hoist is both feasible and advantageous in the foundry. This company operates a cupola which was built in its own shop. This cupola has an 84-inch shell and is lined to 60 inches. Blast is furnished by a No. 9 Sturtevant blower direct connected to a 50-horsepower electric motor manufactured by the General Electric Co., Schenectady, N. Y. The daily melt ranges from 25 to 40 tons. The coke bed consists of 11 barrow loads or about 2000 pounds while the iron charges are 4000 pounds each and are separated by three barrow loads or about 450 pounds of coke. The cupola is situated in the center one of three bays and is provided with two spouts, one opening toward the heavy work bay and the other into the bay where the light work is made. It is situated close to the heavy work side so that the cranes can deposit and lift ladles away from directly under the spout. A short track leads from in front of the other spout and carries a buggy ladle into the light work section of the foundry.

The accompanying illustrations show the mechanical device provided for charging the cupola. Its principal time saving feature lies in the elimination of repeated handling. The iron is only handled once between the stock pile and the cupola instead of three or four times as is customary in many charging systems.

Four men are employed on the furnace in the morning and five in the afternoon. The furnace man and his helper chip out the furnace, repair any broken places in the lining, daub the melting zone with clay, make up the spouts, put up the bottom doors and ram the sand bottom. The other two men wheel away the cinder and

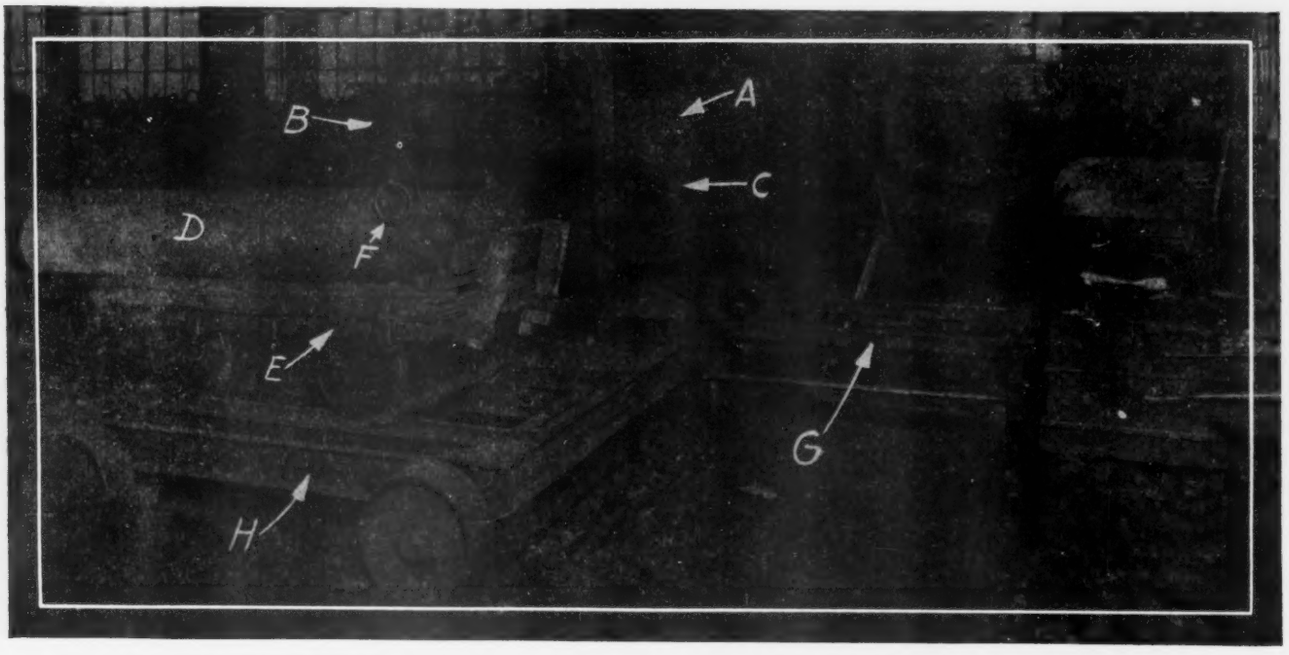


FIG. 1—CARS USED FOR THE IRON AND COKE AND THE ARRANGEMENT OF TRACKS AT THE FOOT OF THE INCLINE

slag from the previous day's heat, prepare the kindling wood and throw it into the cupola. Then they haul up sufficient coke for the day's melt.

The charging stage is quite large. It was built to serve two cupolas, one of which is held in reserve. A large stock of coke always is kept on the stage to provide for any emergency that may arise.

At *A* in Fig. 1 is shown one of the hoppers in which the coke is transported from the stock pile to the charging floor. These hoppers are 5 feet, 5 inches square at the top by 2 feet, 6 inches deep and have a capacity of 37.5 cubic feet. This translated into terms of weight is equivalent to 1050 pounds of coke. The trucks for carrying the coke hoppers are substantially framed with 8-inch I-beams. Each truck is mounted on two solid, square 2-inch axles which run in self oiling 14-inch wheels. A rectangular frame *B* Fig. 1 at one end of the truck carries a locking device on the top for holding the hopper upright. Cast iron cradles *C* Fig. 1 are riveted near the bottom at each end. They are provided with short projecting fingers at regular intervals. These fingers engage in corresponding holes in a flat iron band on each end of the truck and prevent the hopper from slipping while tipping over to discharge its load of coke.

One of the cars for carrying the pig iron charging pans is shown at *E* Fig. 1. The frame consists of four 5-inch I-beams mounted on 12-inch wheels. The top is planked. The pan *D* Fig. 1 is made of a single sheet of ½-inch boiler plate turned up at both sides. The end is composed of a separate piece riveted on. Rings are provided at *F*, Fig. 1, for attaching chains to tip the pans on end and spill their contents into the cupola. The pans measure 5½ x 2½ x 1 feet and will hold a charge of 4000 pounds of iron. The car used for bringing both coke and iron trucks to the bottom of the incline is shown at *G*, Fig. 1. It is simply constructed. Two 6-inch I-beams form the sides. These are bolted together and braced at each end by ¾-inch bolts set through spaces formed of lengths of 1-inch pipe. An *X* frame made of 2 x ½-inch flats is riveted across the center and makes the frame stiff and rigid. The car is mounted on four 12-inch wheels.

The scale car shown at *H*, Fig. 1, is mounted on a track which parallels the iron pile and eliminates the necessity of carrying the iron any distance.

In Fig. 1 is shown the general arrangement at the foot of the incline. The platform next the wall is provided with two short lengths of track. These serve for switches on which cars of coke or iron may be diverted while a loaded car is pulled up the incline or an empty one is lowered.

The hoisting gear and turntable are shown in Fig. 4. They are simple in construction but highly efficient like the other appliances which make up the charging system. The hoisting gear consists of a friction drum driven by a 10-horsepower General Electric motor. As may be seen in the illustration, the motor is connected to a 4-foot pulley by an 8-inch belt. This driving pulley is keyed to a shaft to which is keyed a smaller pulley 10 inches in diameter. By throwing the lever *I*, Fig. 4, to one side the small pulley is brought into contact with the friction band on the cable drum which winds up the cable. When the lever is thrown the other way the friction contact is released.

The inclined railway is brought to the charging platform at the back wall furthest away from the cupolas. It is therefore necessary to provide a turntable in the track to divert the loaded cars from the straight track to the one leading to the charging door of the cupola. Eight chairs with ¾-inch open bearings are bolted to

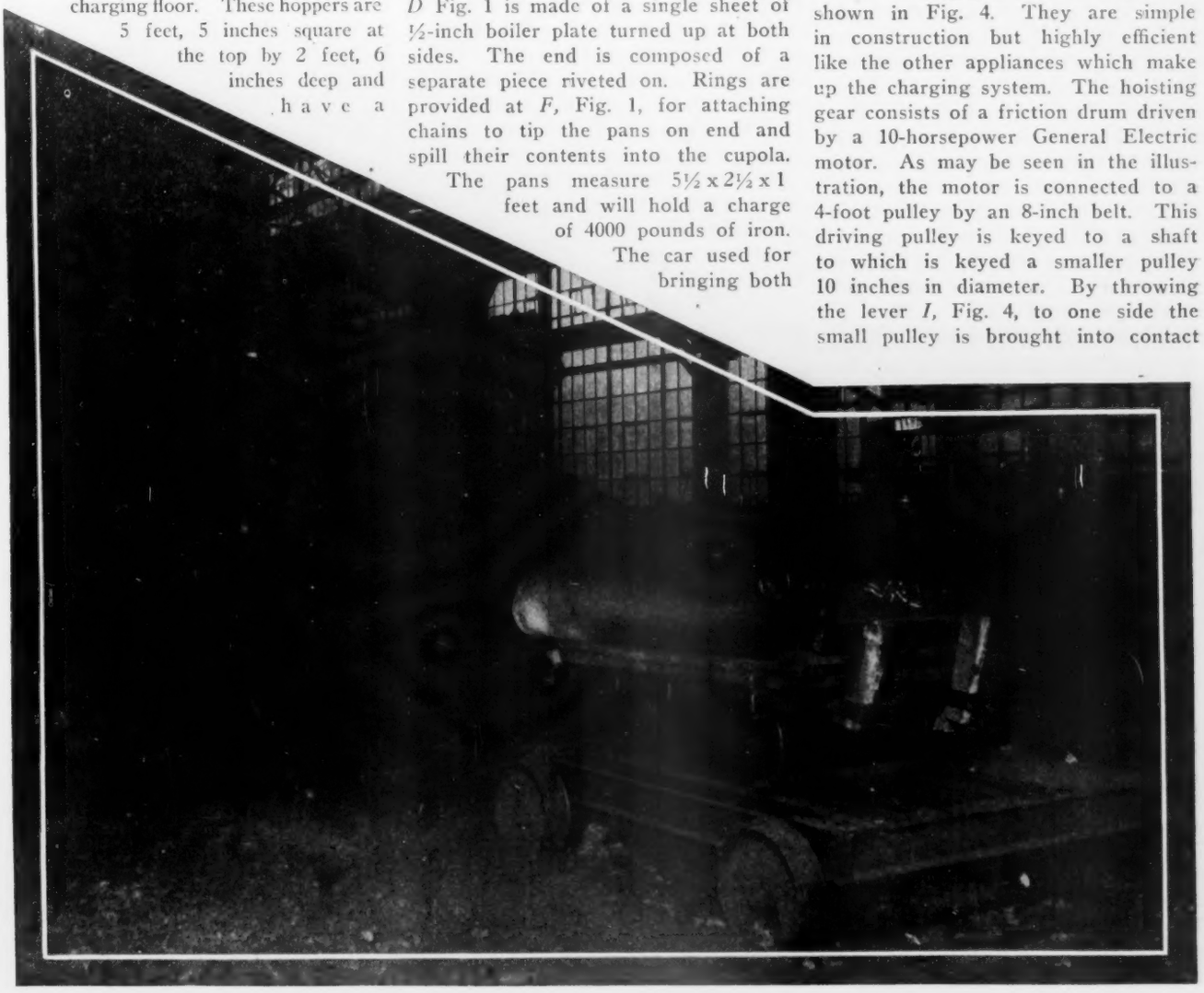


FIG. 2—IRON CHARGING PAN ON THE SCALE—THE INCLINED TRACK WHICH IS MADE OF LIGHT RAILS ATTACHED TO LONG SECTIONS OF 12-INCH I-BEAMS IS SHOWN IN THE BACKGROUND

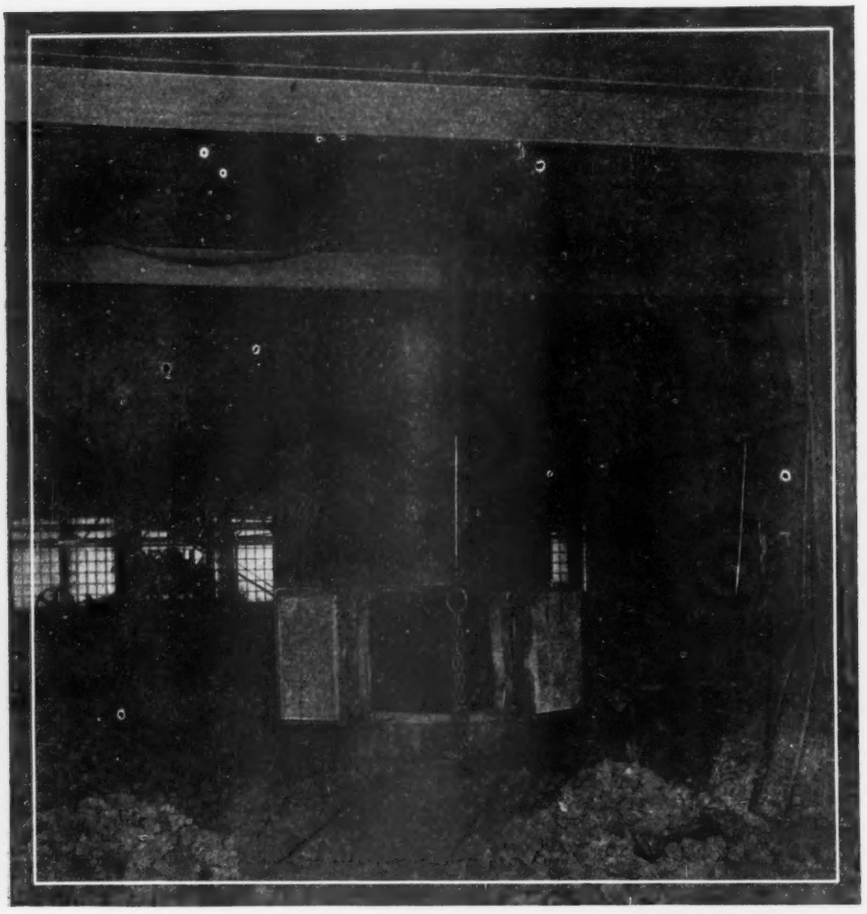


FIG. 3—CHARGING DOOR OF CUPOLA WITH HOIST IN POSITION FOR DUMPING THE PANS

the floor at equal distances on a 5-foot diameter circle. Solid cast iron rollers 3 inches in diameter, having ¾-inch steel spindles cast-in, are set in the bearings in these chairs. The body of the turntable consists of a circular band made from 3 x ½-inch flat bar stock. The bottom edge rides on the rollers and the top edge is provided with four brackets to which the rails and planks are bolted. Two pieces of 3-inch angle iron are set across the diameter at right angles to the rails and help to make the band rigid. A locking device which can be pulled up between the angle irons is attached to the floor, this holds the track on the turntable in line with either the main track or the branch track leading to the charging door of the cupola as desired.

The final item of equipment is the air hoist shown in Fig. 3. The chains on this hoist may be attached to the rings in back of the pans and when the hoist hook is raised the back of the pan is lifted dumping the contents into the cupola. As stated in the first part of this article all iron is dumped directly into the cupola as soon as it is brought up on the stage.

When the first bed in the cupola has burned through, three barrow loads or about 450 pounds of coke are added. This brings the bed to the proper height for charging. The pans are filled with pig iron from the stock pile on the ground floor, pulled up the incline and shoved over to the charging door so that the nose of the pan projects into the furnace. The chains of the hoist are hooked onto the rings provided for that purpose and the contents of the pan dumped into the cupola. Three barrow loads of coke are placed between each charge of iron and the cupola is filled to the door before the fan is started. After the iron commences to melt and settle down, charging continues until there is enough for the days cast. The cupola melts at the rate of 30,000 pounds an hour and there is no difficulty experienced in keeping it supplied with material.

The Bowler Co. operates a general jobbing foundry and among other lines handles considerable quantities of gas engine castings and machinery for rubber factories. A floor of molds for rubber tire molds is shown in Fig. 5. These flasks are rammed on a power jar-ram machine made by the Herman Pneumatic Machine Co., Pittsburgh. A half split pattern mounted on a board which has suitable pin holes for locating the flasks is used for both copes and drags.

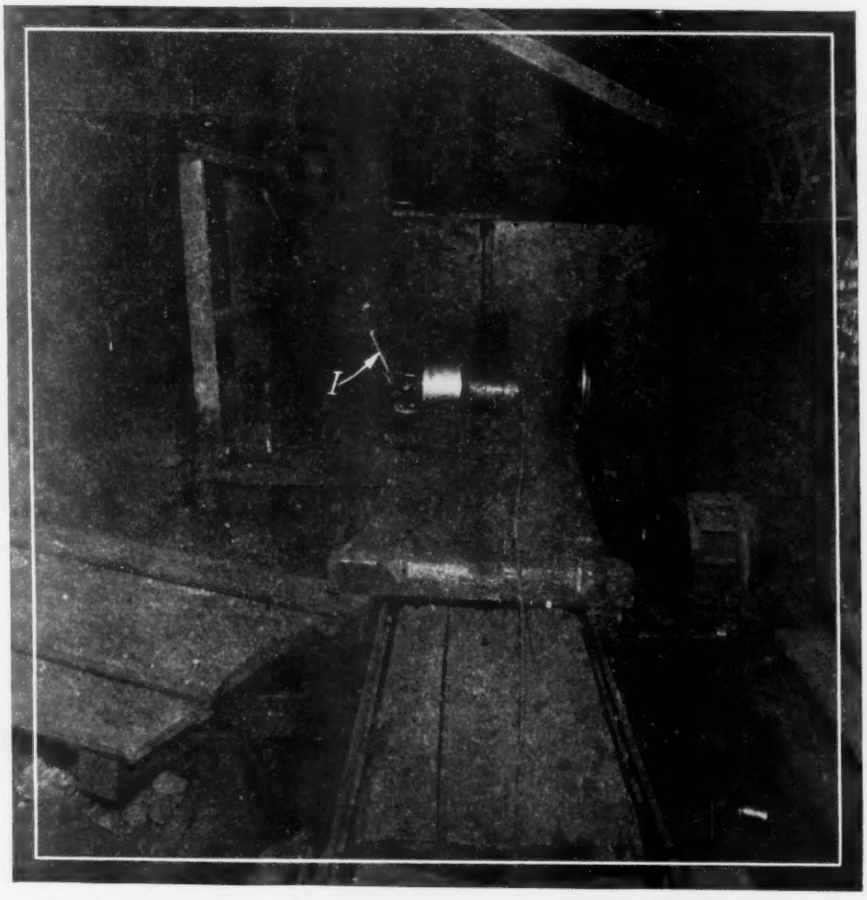


FIG. 4—MOTOR, HOISTING DRUM AND TURNTABLE AT THE BACK OF THE CHARGING FLOOR

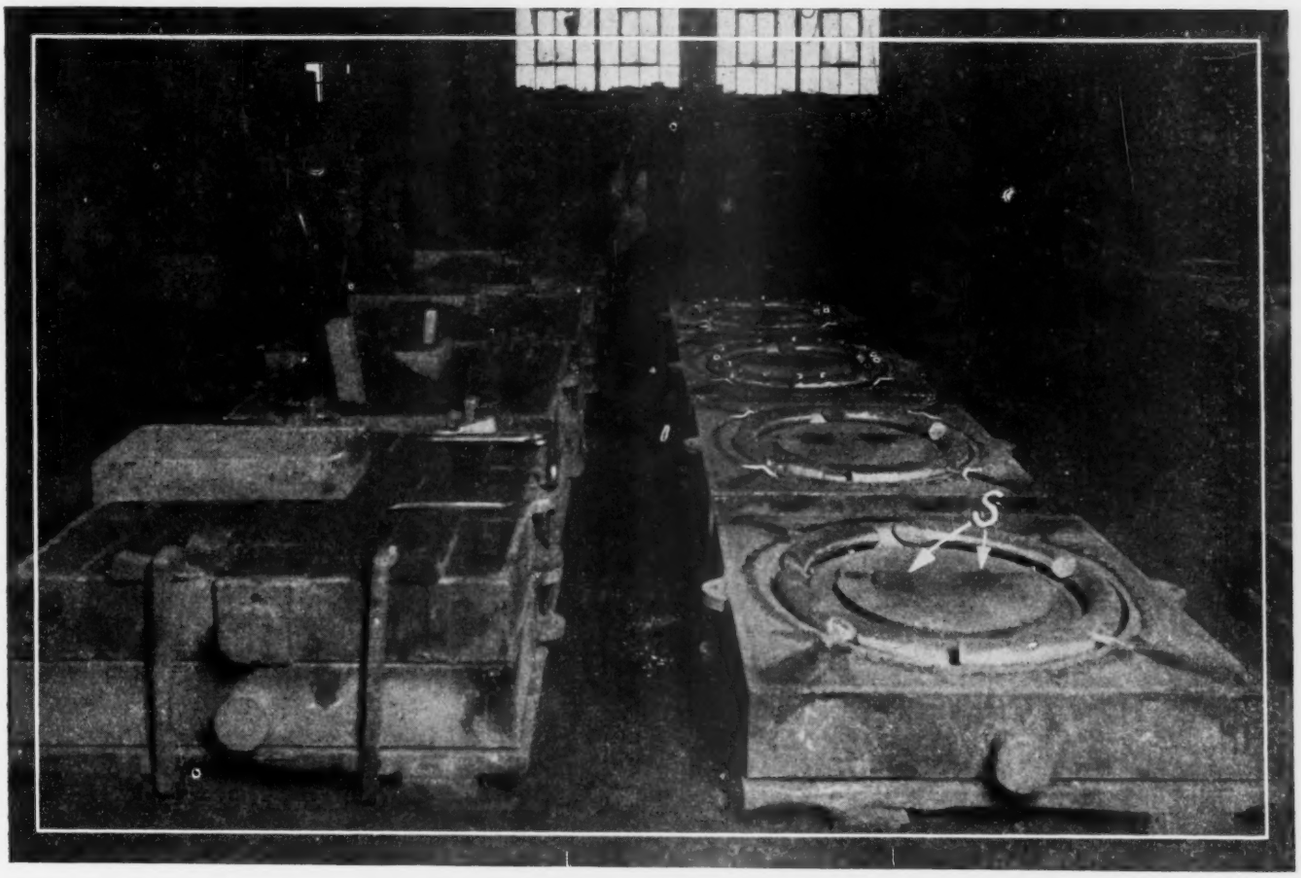


FIG. 5—A FLOOR OF CORE MOLDS FOR AUTOMOBILE TIRES—THE ENTIRE CASTING IS POURED AS A UNIT AND SAWED APART AT THE FOUR JOINTS AFTERWARD—NOTE THE CHAPLETS ON THE TWO SETS OF CORES IN THE BACKGROUND

The drags are all rammed first. A block attached to the board forms the gates and also recesses in which to drop the strainer cores shown at *S*, Fig. 5. A slightly different shaped block is used for forming the gate in the cope half of the mold. It is 12 x 2 x 1 inches and is located so as to extend over the two strainer cores in the drag when the flask is closed.

The floor on which these molds are prepared is served by a traveling air crane made by the Curtis Pneumatic Machinery Co., St. Louis. As may be seen in the illustration the core in the mold is made in four sections. Each section is supported on four stud chaplets while the same number are used on the top side to prevent it from shifting while the mold is full of liquid iron. One 1-inch print is allowed to each core to carry off the vent. The cores are made of an oil sand mixture in half core boxes. The bottom halves are made first and dried and then the green halves are blocked on top of them. A gutter leading to the print is cut in the joint of each half for a vent.

A device for holding the casting while removing the core is shown in Fig. 6. This consists of a 24-inch diameter round plate supporting an

FIG. 6—JIG ON WHICH CASTINGS ARE REVOLVED WHILE THE CORE IS BEING RAPPED OUT

upright bar. The bar carries a boss at the upper end machined to fit into a seat in the cross. The four bolts in the cross are a loose fit for the casting. When it is realized that the core sand in each section has to be removed through a 1-inch hole the convenience of the device which revolves readily will be appreciated. There is sufficient play between the bolts and the casting to prevent it from becoming top heavy.

Patching Doubles Life of Furnace Roof

ONE of the main sources of expense in melting steel in the electric furnace is refactories and their upkeep. The walls of the furnace must be patched frequently and relined occasionally, but the life of the roof is much shorter. For this reason the cost of renewing the furnace roof is probably the largest item in the maintenance of the equipment.

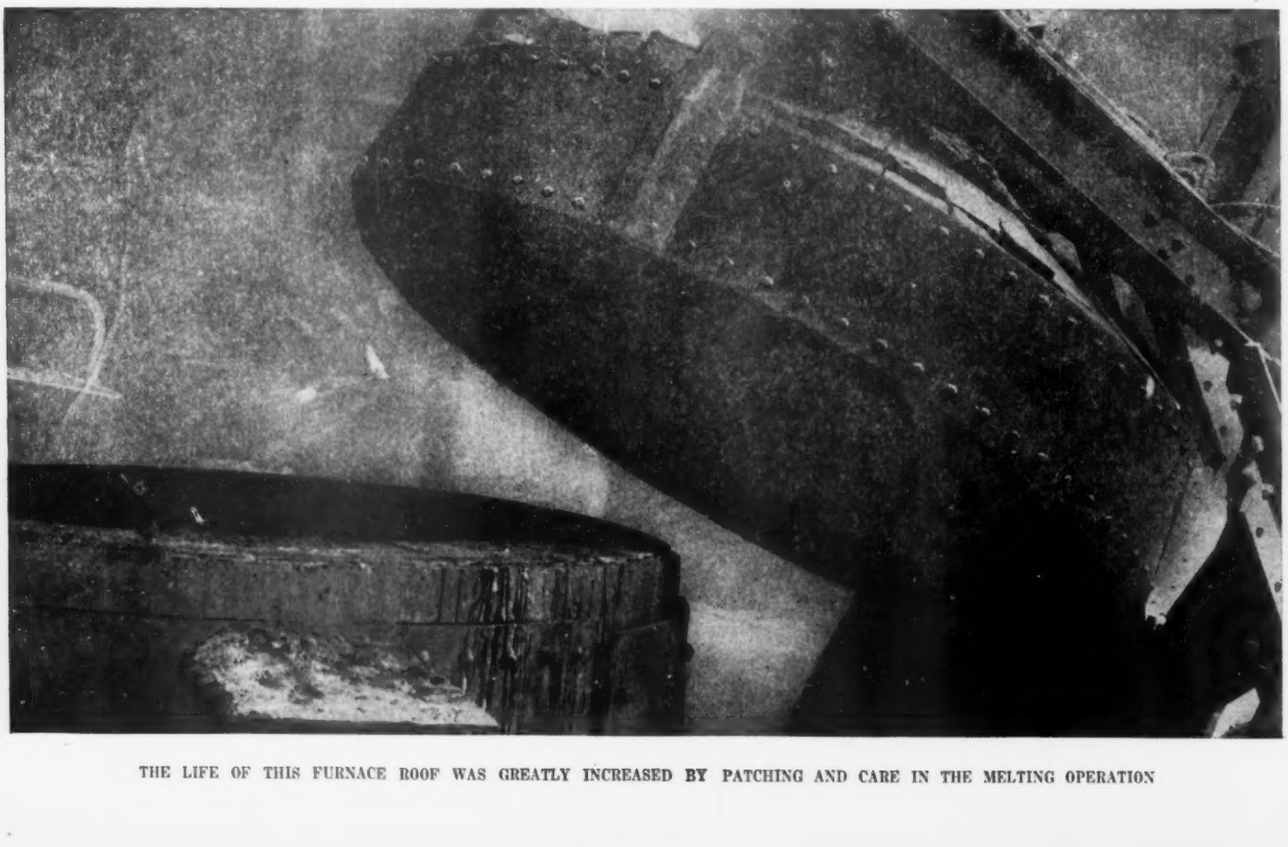
A furnace roof which lasted through 300 heats and is still good for several more is shown in the accompanying illustration. This roof was on a Snyder electric furnace operated by the West Steel Casting Co., Cleveland. The process used is the one originated by the West company. As described in the Sept. 15 issue of THE FOUNDRY, the process requires melting scrap and pig iron in the electric furnace with the addition of small amounts of ferrosilicon and ferromanganese. When this charge is melted the metal contains approximately 0.60 per cent carbon and 0.65 per cent silicon. This metal which has a comparatively low melting point is not superheated in the electric furnace for pouring castings, as it is blown in the converter before being cast. For these two reasons it is unnecessary to heat the steel as high as is usually the custom in steel foundries.

However, notwithstanding this fact, furnace roofs at the West company have not been lasting more than 150 heats and some roofs have been scrapped after 100 heats. When the roof shown in the illustration was put on the furnace it was decided to exercise care in melting and to patch the roof when needed in order to make it last as long as possible. The silica bricks used were of the same shipment from which previous roofs had been made and were judged to be of the same quality. The roof was 18 inches thick on an average. As soon as cracks appeared the joints were plugged with ganister which was worked in between the bricks far enough effectually to prevent the furnace gases from coming through and gradually enlarging the crevices. Patching would have been impracticable were it not that the roof becomes comparatively cool during the night and it can be tilted back so that the mason can conveniently work at it. By patching the life of the furnace roof was extended to 300 heats. With an average of five or six heats a day, this roof lasted slightly over two months.

Buys Aircraft Plant

The International Motor Co., 252 West Sixty-fourth street, New York, has bought the large plant of the Wright-Martin Aircraft Corp. at New Brunswick, N. J. Huge numbers of airplane engines were produced at this plant during the war. Prior to its acquisition by the Wright-Martin interests, it had belonged to the Simplex Automobile Co. It comprises a huge machine shop, gray iron and brass foundries and other departments. The Wright-Martin Aircraft Corp. plans to build a new aircraft manufacturing plant near Newark, N. J.

The National Roll & Foundry Co., Avonmore, Pa., has received the contract for the sheet mill installation at the new plant of Follansbee Bros. Co., at Toronto, Canada. The company also is building the hot mill equipment for the Eastern Rolling Mills Co., Baltimore.



THE LIFE OF THIS FURNACE ROOF WAS GREATLY INCREASED BY PATCHING AND CARE IN THE MELTING OPERATION

Training Men in the Molding Art

Creative Instinct is Instilled in Workmen Under Training by Directing Them Intelligently and Teaching Them to Look for the Reason in All Operations

BY R. R. CLARKE

CREATION is the power to originate, imitation the capacity to copy. All men imitate but not all to the same degree. Some do nothing but imitate, while others follow example only to a certain point where they part from the old and established to enter upon the new and better. Some work automatically, relying entirely on precedent and knowing nothing of whys and wherefores. Others proceed with definite incentive and purpose. They possess knowledge of reasons. It is not hard to beat the habit man, but look out for the one with a reason for his ways.

Men divide between creation and imitation, between those who originate and those who copy. But no man copies in full or gets far from his copying. He cannot. As Kipling says:

"They copied all they could follow, but they couldn't copy my mind.

"And I left 'em sweating and stealing, a year and a half behind."

Imitation is difficult, involving close observation and good memory, two powers frequently lacking. Imitators must have good memories. The same has been said about good liars and the failure of most men indulging the lying habit suggests the probability that few will become world beaters as imitators. Imitation is dependent. Creation is independent. The one draws on external sources, the other on internal powers. Reason is stronger than observation and memory and always more dependable. Let an imitator forget and he is completely done, but a reasoning originator possesses his full powers of recovery and soon gets his knowledge all back again.

Foundry Work Creative

Founding is both imitative and creative. The same basic principles always have and always will be observed but the possibilities of variation will point to changing methods so long as progress remains the order of industry. Here we might define our terms more closely. An imitative mind works entirely from precedent and absolutely is void of principle, reason or purpose. It knows nothing of whys or wherefores, and is not concerned about them. A creative mind is analytic, possessing knowledge of principles and how to apply them. It recognizes precedent but is not dependent upon precedent alone. It may direct along imitative lines but not in an imitative way. Creative men are not strictly copyists even when they knowingly follow that which has gone before. Given certain principles they quickly reason to results though such application never before has been made. Their greatest power lies in their ability to do those things for which no model has ever been set. Besides this when necessity for imitation arises they make the best imitators in the world. They fathom mind where others merely comprehend method.

Both imitative and creative minds may be traced to natural causes, and in some cases to heredity. However, creative power is an outgrowth of the mind and like all other powers of the mind is capable of cultivation through exercise. There are lazy minds as well as a lazy bodies and he who from sheer laziness refuses to use his brains, scarcely can blame nature for his natural standing among men.

Thinker and Imitator

Our chief interest here is in molders, those men who make castings; some in a creative, others in an imitative way. One molder takes a new pattern, sets his flask, lays the pattern down and starts to riddle sand, all in an automatic way. Another takes the pattern, looks it over carefully, goes to the core room to examine the cores, lays the pattern on a followboard, studies the position carefully, shifts it. Then he studies the entire job and thinks through to its finish before he sets his sieve and starts to work with confidence.

There are two distinct classes of imitative men, those who pattern after others and those who imitate themselves. Among the latter are those who evolve a method and never change it. The self-imitator cuts a groove, a rut and never gets out of it. He is a habit man whose value, whatever it may be, remains always constant.

The automaton is the zero of constructive ability and accomplishment and forms the weak and breaking link in the chain of dependability and progress. He never is a front rank man, but always is a poor and stumbling follower. Therefore, progressive organization must either eliminate him or educate him to a higher standard.

The past two years has furnished the writer an abundance of evidence along these lines when he stepped into a field of old and haphazard method where ability of the most mediocre type prevailed. . Unhappy and expensive as that experience has been it possesses weight in strengthening the present argument for better training methods along lines that will develope reasoning power. Men who learned molding in an erratic, nonthinking, automatic way and have followed the beaten track for years have acquired inertia, difficult to overcome. Their minds, spirits, habits and inclinations stand against any change so that they keep in a rut, continue to lose castings and to seek alibis. Men are like children in this respect. They pass through a plastic and receptive stage, but having passed that stage they intend to remain just as they are.

Such was the situation the writer found in taking charge of a shop 18 months ago. The only possible solution seemed to be to build from the ranks the creative ability desired. Today our molding talent stands 80 per cent newly developed. Our workmen are as yet in the making but that making includes the elements of creative skill the possibilities of which are incalculable. What are the elements, the factors that endow a molder with the power to think and originate, make him an independent workman and raise him head and shoulders above another?

What is Art?

An analysis of the molding art will help to answer this question. In its true sense art has come to mean the application of knowledge to affect certain desired results. Art is really science plus applied skill and has therefore its two sides, namely knowledge and skill. The accomplished musician, for instance, must possess a profound knowledge of the elements of good music and the skill

to produce that music from some instrument. Measured by this standard, molding is a perfect art. It possesses its inviolate principles and requires its unerring skill.

Many molders do not know principles. Instead, they follow rules. Between rules and principles is a wide gap. An apprentice is told always to tamp a green core soft and his rule is to do it without reasoning. Some day he faces a deep, in-striking green sand pocket. Now a pocket isn't a core to him so, his rule fails to cover the case, as it does not forbid ramming the pocket hard. So he spoils the job. If at first he had been told that the nearer green sand is entirely surrounded by metal the greater its gases and the less their avenues of escape and consequently the softer and more open that sand must be, then he would have known a guiding principle covering the pocket as well as the core.

The illustration covers venting as well. If the mere rule to vent a core well is given, the analogy between core and pocket may completely escape recognition. However, if the principle is stated the identity of the two will not be overlooked. The example is by no means hypothetical nor representative of an isolated instance. Apprenticeship in the majority of foundries does not teach a boy principles or even rules. In the best sense of the term it does not really teach him anything. It rather affords him a mere opportunity to observe and imitate, to associate with and watch others that he might do like them. He learns to do many things the right way by first doing them the wrong way and then being corrected, all the while considering the subject lightly or seriously as his temperament and environment may respectively determine. In short is the average apprenticeship a well ordered course of basic instruction or a mere foundry environment for absorption?

Instilling the Viewpoint

Molding is a serious business. Did you ever take a boy beginner into the office and impress upon his mind the seriousness of his undertaking and the vast importance of learning to do things in the right way, of getting down to bedrock truth in all things, of digging for motives and seeking after reasons for things? And after that do you hand him over to your best molders or an individual teacher for painstaking instruction? Or do you send him into the foundry, give him a gated up pattern of standard design and insist that he go to it, hammer and tongs, to develop into a moneymaker from the beginning?

The average molder has more skill than science. He can make a mold which is well formed but which may not be mechanically correct. Some of the worst castings ever made have come from the finest appearing molds. The fact is not to be disputed that the science phase of the molding art is of greater value than the skill. A rough cut gate, for instance, if it embodies the correct mechanical principles may yield a sound casting but one lacking these principles will not, no matter what its beauty or symmetry. Skill comes, through practice but knowledge must be sought. Therefore, the science of molding should be made the main feature of training.

Making Molders

The first important step in developing a molding organization is the choice of men for the purpose. A molder requires brains, natural ability and handiness, willingness to apply and learn and a strong loyal and cooperative spirit. Place these men under a good instructor with a sound system of instruction. A good instructor is always one who knows the game, but because a man is a good molder is no evidence he will make a good instructor. He who imparts his knowledge to another must possess the natural or acquired ability to teach.

The main factors in developing creative molding are:

First. A fair intelligence including thinking power, good judgment and abundant forethought.

Second. Power and inclination to analyze.

Third. A thorough understanding of basic principles as embodied in cause and effect on which the reasons for methods are established.

Any molder carefully chosen and trained along these lines will scarcely fail of creative power. The why of things wherein lurk the principle has ever constituted the burden and demand success in training men.

The merit of text book method long has engaged the writer's thought. Such a method would tend to place the art on a scientific basis and put the burden of effort upon the apprentice which is a fundamental of good teaching. The theoretical phase of any instruction recognizes the value of the text book, so why not the practical? A simple expounding and elucidating of the principles of molding alone with a compilation of that vast supply of information necessary to high class workmanship all in printed form would prove a valuable asset in training men. The apprentice then would get the idea in both abstract and concrete form. This is practically the same method as that observed in teaching such subjects as chemistry, physics, geology and metallurgy where the textbook states and the class room or laboratory demonstrates.

Why All-Around Mechanics are Few

Undoubtedly the influences responsible for the scarcity of high grade mechanics are many and diversified. The trend of modern practice is toward specialists, chiefly due to duplication and rapid production work. We speak of the old-time molders, and of what they knew and could do. They wouldn't prove satisfactory in some of our modern foundries, but many of them knew molding as men should be taught the art today. They worked on a knowing, reasoning, self-determining basis rather than on a mere mechanically duplicating procedure.

Manual training and training schools seem to be exclusive to high schools and technical institutions. Why could they not be profitably made a part of many great manufacturing systems. The thought was presented forcibly in an address before the Cleveland Engineering society delivered by A. P. Fletcher of that city. In that address Mr. Fletcher holds the employer, the employe and the school responsible for the lack of skilled mechanics and after reading his paper the matter is not difficult to see how all three have fallen short of perfection.

Instructing Men Efficiently

If in the foundry only two or three men are undergoing a course of training at a time, they may be instructed verbally on the basic truths of the art. When that number increases to eight or 10 the task becomes much more complicated. It was partially this complication that led the writer sometime ago to try out a new plan. This consisted in writing up in the basic principles of molding as applying to the different features of the work in plain and concise language. In compiling this data only one subject at a time is considered. It is plainly discussed as to the whys and wherefores of the case, and the application in daily practice is pointed out. Copies of these then were typewritten and one copy was given to each man with instructions that he study and master it and request further explanation on any part he did not understand thoroughly. As a check on his application to the task

questions were asked casually in the daily examples of the different subjects as they appeared in actual practice.

On the subject "Why use charcoal," for instance, attention would be called to the oxide sheet of metal clinging to the ladle side. The men in training would be asked what it was, what caused it and how charcoal could aid in preventing it, these features having been dealt with in the written discussion. If he had studied his lesson he knew, and if he didn't know it was held to be an omission.

In the various typewritten forms which have been mentioned the writer tried to cover each individual feature of molding such as condition of sand, tamping, core-setting, pouring methods, pouring temperatures, metal protection, weighting, clamping, etc. In the hope that some of these might prove of practical value to readers of THE FOUNDRY a few of the more important are offered. These include instruction sheets on conditioning sand, swabbing molds, using charcoal coverings on molten metal and rapping and drawing patterns.

Conditioning Molding Sand

GOOD sand is the prime requisite of good molding. When the sand is right, you may obtain good results, under conditions that would cause failure with poor sand.

Good sand is that which is cold, free of metal spillings, has enough new sand along with old to give it good strong body, is neither too wet nor too dry for the work at hand. It is strictly uniform all through and contains few if any lumps. Sand which is too wet causes the casting to shrink, cut, scab, blow, draw and present a honeycombed structure, while that which is too dry crumbles, warps, and falls out under action of the metal.

The practice of facing the pattern with good sand and using most any kind of sand as a filler-up is bad. Too wet sand lying next to properly tempered sand, will cause the good sand to draw moisture and become too wet. Dry backing sand does not give that required bond between itself and the facing. If there is any one place where good sand is necessary it is around the gates where the metal is in motion. Using poor grades of sand as a filler-up produces a strong probability of getting it next to the gates and making trouble.

Different alloys work best under different conditions of sand. As a general rule alloys containing much zinc such as yellow brass, brazing metal, tobin bronze, muntz metal, etc., do best with the sand which is rather dry. The same is true with aluminum. Dry sand may be tamped much harder without giving trouble than wet sand. For this reason when making heavy castings such as pin brass where the mold has to be hard-rammed it is always best to have the sand rather too dry than too wet. In making phosphor bronze where the metal burns the sand severely, it also is good judgment to work the sand dry and ram it hard. Dry sand always should contain sufficient new sand to give it a good bond and body.

Sand tempers best when it is hot and consequently steaming. It is difficult to get cold sand properly mixed and tempered. For this reason, water should be thrown on sand as soon as the castings are shaken out. The sand should be cut over at this time to make the tempering more easy and efficient. Sand tempered in the evening and left over night is by far better than that tempered the next morning.

In wetting down sand it is best to have the sand spread out and thus allow a uniform distribution of the water rather than in a heap. In this condition the sand should then be cut together thoroughly two or three times, thrown into a heap and then riddled. In adding new sand it also should be thrown over the old when spread out.

No molder ever should start molding before first making sure his sand is right through and through. It is better by far to take time to get sand into proper condition than to take chances with it when not in this shape.

To prepare sand begin immediately after it has been shaken out, first spread it out, wet it down, add new sand, cut it over, throw it into a heap not too bulky, tramp it down, cut it over and riddle it with the riddle hanging at least 5 feet above the floor.

Core sand mixed with molding sand weakens the bond and makes the sand unduly coarse. In shaking out cored castings care should be taken to exclude all the core sand possible.

Heavy castings dry and burn sand severely. Such sand should always be built up with a good supply of new sand and well cut over.

Excessive quantities of partings and different facings tend to weaken the bond of sand.

Some grades of sand will stand heat better than others. Sand that will answer well for light work often will fail on heavy work. In this shop are two grades of sand, Cedar mountain sand and Santiago sand. Cedar mountain sand is coarse and resists heat well and should be used where the casting is heavy and bulky. Santiago sand is fine and has a stronger bond. This is best for the light and medium weight castings. When mold dried Cedar mountain has a strong bond while Santiago has no bond at all.

Judging condition of sand is based on the sense of feel or touch and may be perfected only through practice and a fine training of this sense. Under normal conditions wet sand feels colder than dry sand, it is more tenacious and invariably much heavier.

Why Molds are Swabbed

SWABBING around a pattern prevents the sand bordering the pattern edge from crumbling and breaking away in rapping and drawing. It is evident that around the pattern and not all over it is where the swabbing should be done. When the water is sprinkled on the pattern the excessive dampness causes the pattern to swell and warp out of shape. It is because of this that split patterns, made of wood, often fail to part in lifting the cope from the drag.

No more water than is actually needed ever should be used in swabbing as any excess water will sink quickly into the sand close to the pattern and cause disturbance to the metal. Certain parts of molds often will permit little or no water at all and these parts always should be watched carefully in swabbing. Green sand cores in bushings, cope parts of patterns such as core prints on bushings molded on end where the cope of the pattern lies well within the drag metal surface and around the gates where they join the castings, all are examples of those places where little if any swabbing is permissible. Swabbing inside the mold or in the gate should never be considered and as a general rule in green sand molding the less water used, the better. Most parting compounds will not take water and consequently, make trouble. For this reason it is often well to brush the face of the mold with a soft dry brush and blow any loosened parting well off before attempting to swab.

Gated patterns containing many portions difficult of access by brush

swabbing can be dampened best with a blow pot. In resorting to this means, care should be taken that the water falls on the mold in a reasonably fine spray and is evenly distributed.

The swab brush should be of fine camel hair and adopted in size to the work for which it is to be used.

The best results in swabbing require clean water. The molder who allows his swab pot to become bottom heavy with sand that constantly mixes with the water making it thick and mushy need not expect a clean or efficient job of swabbing with this dirty water.

Tips on Drawing Patterns

PATTERNS should be rapped only to that extent which will allow drawing without tearing. Patterns with good draft require little rapping. Excessive rapping produces oversize castings which are too heavy as well as out of shape. This also enlarges core prints and causes cores to shift out of position.

A sharp spike and a rapping bar of correct weight are important to good rapping. A dull spike and a heavy bar often will drive the pattern deeper into the sand making the casting oversize. It always is well to have different sized spikes and bars for the different sized patterns. Marking the pattern as little as possible is an ideal which should be sought in rapping.

Rapping should be uniform. It should not be hard in one direction and light in the opposite direction. Large patterns often have metal rapping holes, and metal drawing holes. In no case should the one be used for the other. Frail or weak patterns should be rapped lightly at different points. The same is true of rings, bushings, and crosspieces. It is better to rap a ring-shaped pattern lightly at four points than hard at two points.

Deep patterns of little draft should be rapped at both top and bottom, the bottom rapping to be done in ramming up. The same procedure should govern with deep bushings having green sand cores. In these bushings the outside may be rammed first, the pattern rapped from the inside and then the core may be rammed. In all cases the pattern should be given all the protection possible in rapping to preserve it.

Using Charcoal on Metal

THE scum which forms on the surface of melted nonferrous metal represents spongy dross and impure metal. This scum is caused by the oxygen in the air or atmosphere resting on the metal surface and causing it to form a metal oxide which is really scorched metal or metal burned to ashes. Nothing will burn where there is no air and heat will not injure metal if it is protected from the air. The fine metal wire in an electric lamp becomes white hot, yet never suffers until the glass is broken and air is admitted. The effect of oxygen in the air on the heated wire is practically the same as upon the surface of melted brass.

Under the drossy top of melted brass, the metal is always clear and limpid, but the scum rides on the surface of the metal and flows off with the metal stream in pouring, producing dirty and spongy castings. In Baldwin metal this scum never appears because in this metal phosphorus which has the power to destroy the effect of oxygen, is used.

Burning charcoal takes up all the oxygen of the surrounding air and passes it off as a gas. When charcoal is thrown on melted metal, it uses up the oxygen of the air over the metal and keeps the oxygen from reaching and ruining the metal. Besides this it has the power to purify metal that has been ruined by oxygen. It does this by taking the oxygen out of the oxide and leaving pure metal behind. Oxide is oxygen chemically combined with metal. An example of this oxide is the sheet of burned metal often seen clinging to the side of a ladle after pouring. Charcoal does its work only while it is burning and that is why the metal surface is cleaned by skimming off the charcoal which has burned to ashes and replacing it with new.

Castings poured from metal covered with charcoal are always cleaner, stronger and more solid than without it. The rule of this shop is to use charcoal coverings faithfully, except on Baldwin metal, and metals high in zinc, such as yellow brass, brazing metal, etc. These metals are exempted because they are hard to skim and also because they contain elements that correct the oxide evil.

Throw a layer of charcoal over a pot of metal, push the charcoal quickly aside to get a peep at the metal underneath and notice how clear, thin and bright the metal looks. Cover the top of a gate at once, after pouring it, with pulverized charcoal and after it has cooled note how clean and pure the solid metal appears. These experiments will illustrate the function of charcoal and the great amount of good it will accomplish toward making clean solid castings after they are machined.

Pittsburgh Foundrymen Hold Annual Dinner

Isaac W. Frank, who recently retired from the presidency of the United Engineering & Foundry Co., Pittsburgh, was the guest of honor of the Pittsburgh Foundrymen's association, of which he was one of the organizers, at its annual dinner held Dec. 15. Introduced by C. S. Koch, president of the American Foundrymen's association, Mr. Frank, in a brief talk, declared that efficiency and increased production were the solution of the high cost of living problem. The speaker reviewed in interesting fashion the early days of the Pittsburgh Foundrymen's association and the evolution of the foundry industry from the days of the eye test for iron and of hand-mixing and ramming of sand.

Brig. Gen. Edgar Jadwin, formerly colonel of the Fifteenth engineers, a Pittsburgh regiment, who recently returned from abroad, gave his experiences both in connection with the prosecution of the war and during his service in missions to Poland and Ukraine. E. Lowry, United States attorney for western Pennsylvania, spoke of bolshevism, its causes, effects and solution.

The dinner was in charge of the entertainment committee of the association, which consists of O. C. Dobson, the Carborundum Co., chairman; C. W. Forcier, Pittsburgh representative of the Crucible Steel Forge Co., Cleveland, and the Exeter Machine Works, Pittston, Pa.; G. A. Bauman, of the Jones & Laughlin Steel Co., Pittsburgh; C. L. Kirk, of the Kirk Supply Co., Pittsburgh, and L. W. Mesta, of the Mesta Machine Co., Pittsburgh. More than 350 were present at this dinner.

The annual report of R. T. Baker, director of mints, shows that during the 1919 fiscal year the government made $8,369,971 on its minting operations. Of this amount, $4,136,777.58 was made through the manufacture of nickel and bronze coins. Pennies minted totaled 466,859,600.

Efficient Rig For Making Cylinders

All Working Faces of the Rigging Were Machined Accurately to Insure the Different Parts of the Mold and Core Being Assembled in Their Proper Relative Positions

BY J. R. ANDERSON

STEAM cylinders for packing cotton are made quite extensively in southern foundries. It is the practice in some shops to make them off a whole split pattern, using a dry sand core made in halves and pasted together or a loam core and pouring the castings horizontally. In other shops the cylinders are molded horizontally, but are afterward turned up on end and cast vertically. The method described and illustrated in this article, in my opinion, is better than either of the foregoing. Many times I have made the mold and core complete in 10 hours. It is safe from runouts and is rapid.

The shape and dimensions of the castings are shown in Fig. 1. It is simply a plain straight barrel with an exterior flange at one end and an interior flange at the other. There are also two feet at one end to bolt the casting in position when in use. It is 8 feet long by 30 inches inside diameter. It has a metal thickness of 1½ inches and weighs 4500 pounds.

The mold is made on end with the exterior flange down, in a round iron flask. This flask consists of eight sections. The bottom plate and drag, shown in Fig. 2, is a one piece casting. Six sections, each 16 inches deep, the first provided with a pocket on each side to accommodate the two brackets form the cheek. The cope is a shallow one piece casting.

The core arbor shown in Fig. 3 is cast in eight sections. These sections are then assembled and bolted together

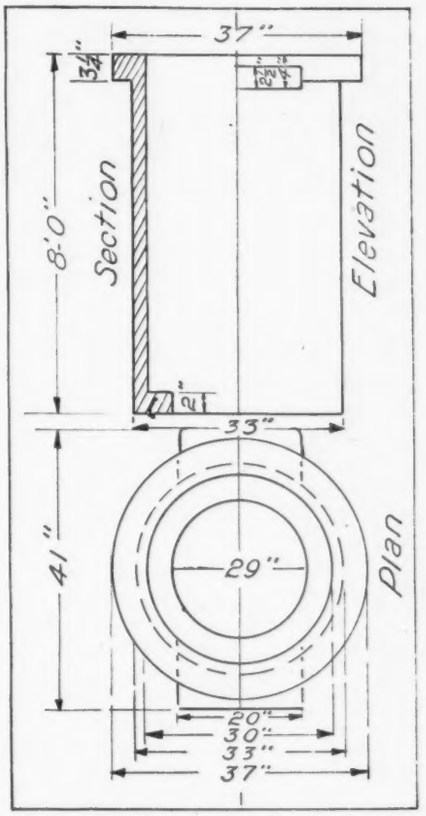


FIG. 1—PLAN, SECTION AND ELEVATION OF CYLINDER FOR PACKING COTTON

in groups of four. The joints of the flasks and core arbors are machined to insure accuracy in assembling the completed mold.

The pattern used for making the cylinder is shown in Fig. 4. This is made from a pulley pattern. It is shown resting on a plate which has been turned to true center on a lathe. This plate is provided with four pin holes by which to locate the flask. There is also a projection in the center which fits into a recess in the bottom end of the spindle.

In making the mold, the plate, pattern and spindle are set as shown in Fig. 4. Loose pieces to make the exterior flange and the two brackets are assembled in place and the first section of the cheek is set on, filled with sand and rammed. The sand is scraped off flush at the top and a stripping plate put on and clamped. The crane hook is then fastened to the loop in the top of the spindle and the pattern drawn. The cheek is lifted off and set down on suitable stands. The spindle and pattern are returned to the plate and the remaining sections of the cheek rammed and lifted off in the same manner. The cheek sections are then bolted or clamped together in pairs, finished, blacked and placed in the oven.

The drag, shown in Fig. 2, is simply made. A thickness of cinders is first placed in the bottom of the flask which is then filled with sand rammed. The sand is scraped off flush with the joint, and a recess in the center of course is left open to serve as a seat for the core.

One section of the core arbor is shown on the plate in Fig. 3. It is provided with a spindle projecting 1½ inches on the bottom side which fits into a corresponding hole in the plate.

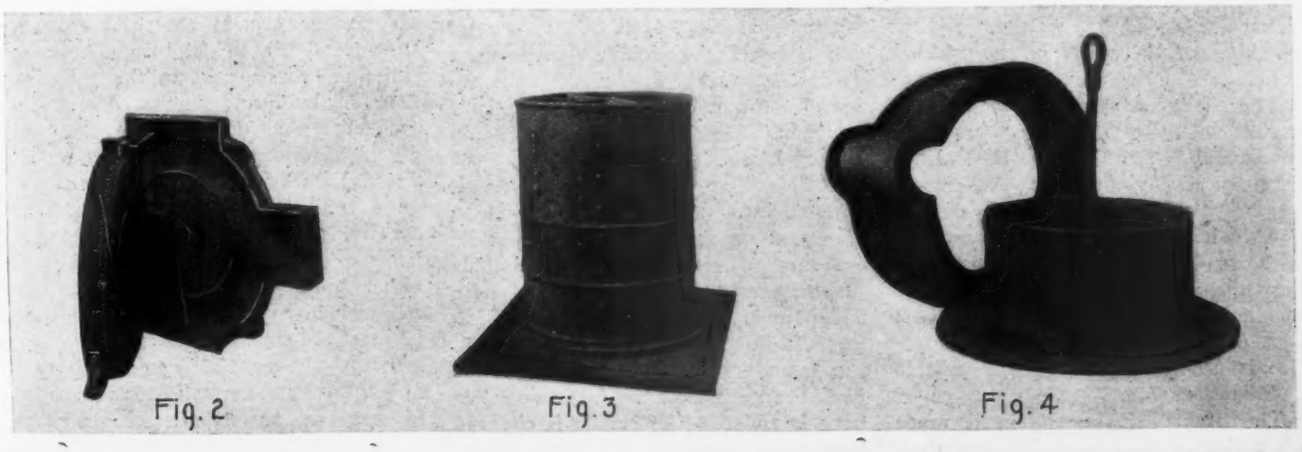


FIG. 2—THE BOTTOM PLATE AND DRAG, ALSO THE CROSS USED TO BIND THE MOLD FIG. 3—ONE SECTION OF THE CORE ARBOR ASSEMBLED ON THE BOARD READY FOR THE COREBOX FIG. 4—PATTERN AND PLATE ON WHICH THE CHEEKS ARE RAMMED

The plate is also provided with pin holes near the edge for locating the corebox. Hay rope is wound around one section of the arbor in each half core to allow for contraction. The corebox is made of wood, and is split vertically in two halves. The arbor is 25 inches and the corebox is 30 inches in diameter. This leaves a sand thickness of 2½ inches. The same thickness of sand is allowed in the cheek. It is thus readily apparent that although the assembled mold is quite bulky the total amount of sand employed is not large. For the same reason the mold and core do not require much heat for drying.

In assembling the mold the drag is first placed in a level position. A slender dough roll made of two parts flour and one part fine sand is laid in the core print and the first half of the core is lowered into place. The inside of the core barrel is rammed full of sand to a height of about 10 inches as a precautionary measure in case the iron should work its way under the core. The first section of the cheek is then lowered and clamped to the drag, after which the mold and core are picked up and lowered into the pit where the remainder of the assembling takes place.

As will be noted in Figs. 2 and 4 the flask is provided with an extension to accommodate a gate leading to the bottom. This gate while continuous, is staggered at each joint of the cheek to break the fall of the iron and prevent the force of the metal from washing into the sand upon which it falls.

Foundryman Writes of Cupola Practice

BY T. N. BURMAN

THE cupola appears to be an instrument which any one could operate without much previous experience and obtain good results. Superficially all that seems to be necessary and, in fact, all that is necessary is to locate a tapping hole and a slag hole, then put in some wood to start the fire, add a bed of coke and when this gets burnt through, charge the metal and the coke layer at a time, then put on the blast and allow the iron to melt and run out the tapping hole, charging more metal and coke until you have all you need for casting. This almost any one can do and get some kind of results, but the writer has found through many years of experience in charge of eight or nine different foundries that the way these various steps are carried out makes a big difference in the results obtained.

In one of the first cupolas operated by the writer he found that by changing the lower tuyeres of the cupola which was 48 inches in diameter inside of lining, the melting capacity was increased from six to nine tons an hour without any other changes in the melting practice. The change in the lower tuyeres also was beneficial in increasing the life of the lining and decreasing the required patching of the walls in the melting zone.

The change consisted in making the outlets of the lower tuyeres narrower and higher than the ones which were originally built in the cupola by the manufacturer. In the case of a 48-inch cupola which was furnished with six lower tuyeres, with openings into the cupola 3 x 14 inches, the openings were changed to make them 4 x 8 inches. The following practice is used by the writer to melt in a 48-inch cupola.

The breast of the cupola is made up with a mixture consisting of half molding sand and half fireclay. Two 1¼-inch holes are made in the breast —one with its lower edge on a level with the bottom of the cupola and the other 2 inches above it. The bottom is made after the breast is put in and the walls have been patched up where needed with a mixture consisting of half new molding sand and half ground fireclay to which a little mica has been added. The bottom is formed by tamping in a 2-inch layer of gangway sand which is covered with a 2-inch layer of used molding sand. This is carefully tamped and a level is used to adjust the pitch so that all parts of the bottom slope to the tapping hole. The sand in the bottom should be damp but care must be taken to see that it is not too wet.

A wheelbarrow load of kindling wood is used to start the fire. The smaller pieces are laid carefully on the bottom and stood up along the sides. At two opposite tuyeres the finer wood is arranged to cause it to light easily, then the larger pieces of wood are placed on top, being laid crosswise so as to make air spaces which will give an opportunity for a free draft. The first lot of 800 pounds of coke is dumped on the wood and the cupola is ready for lighting the fire. This is done regularly at 12:15 p. m. When a good fire is burning and blue flames come from all over the top of the coke another addition of 700 pounds of coke is made. After the blue flames again appear above the coke charging the metal is started. The pig iron is broken into quarter size pieces. A thousand pounds of it are put in first on each charge, then 1000 pounds of scrap are added and covered with 215 pounds of coke. A flux consisting of 40 pounds of limestone and 1½ pounds of fluorspar is added to each charge except the last two when none is added. The cupola is charged to the doors before the blast is put on. At 2:15 p. m. the blower is started. It gives a 14-ounce pressure.

In five or six minutes after the blast is put on iron begins to melt but the cupola is not tapped until from 10 to 13 minutes after iron comes. A tapping rod ⅜-inch in diameter is used to ream out the core and a ¾-inch diameter rod serves to finish making the tapping hole. The lower hole is tapped first. Six hand ladles of the first iron are used to heat up the ladles. The stream is kept running continuously throughout the heat. The metal runs into a 1000-pound catch ladle which assures thorough mixing. From the catch ladle it is caught in hand ladles and in bull ladles by the molders. The cupola tender directs the molders in catching the iron but the molders know their turn and little trouble is experienced in this operation.

The upper tap hole is never used unless the iron melts faster than the lower hole will allow it to run away and rises high enough to run out of the slag hole. In such cases the upper hole in the breast is opened and kept open until the level of the iron in the cupola falls to its normal point, when the upper hole is closed.

In order to have satisfactory melting conditions at all times it is necessary to be certain that the coke is strong and low in sulphur. The coke and flux are brought to the charging floor in bulk and measured out for each charge as needed. The scrap and pig iron, however, are weighed on industrial cars which run on narrow-gage tracks to the stockpile. Each car holds 1000 pounds of either pig iron or scrap and so enough of either one for a charge can be weighed in a single car. It is then taken to the cupola floor ready for charging into the cupola. Ten to 30 cars of pig iron are kept in stock in order to have a variety from which to make up the mixture, although not

(*Concluded on page* 41)

Casts Large Tonnage of Aluminum

Conveying System Reduces Required Floor Space—Castings Carried Through Center of Foundry on a Platform Conveyor—Experimental Melting Furnace Being Tried

LARGE production with a minimum of labor is made essential by the great demands of the times and the limited supply of workers. This is obtained in casting plants by concentrating on repetition work insofar as possible, by specializing on certain classes of castings and by equipping the plant with mechanical appliances for performing operations formerly done by hand. Marked progress has been made in this direction and while the many recent installations are designed to reduce production costs, nevertheless nearly every foundry now being built contains some new departure in mechanical operation which makes its installation a milestone of latter-day progress.

To a large extent iron, steel and nonferrous foundries are confronted with similar problems for increasing production, although there are many differences in practice which make the problems of each type of plant individual. As a rule the tonnage of iron and steel foundries is much greater than the average of that of nonferrous plants, but the foundries operated by the Aluminum Manufactures, Inc., formerly the Aluminum Castings Co., Cleveland, are of such large capacity that the output equals, if it does not exceed, that of some of the largest iron and steel foundries on the North American continent.

Recently the Aluminum Manufactures, Inc., completed the erection of another large aluminum foundry at Detroit which rapidly is attaining capacity production and now is melting more than 80,000 pounds of metal daily.

Continuous pouring and an automatic system for removing the castings from the molding floor have made this remarkable tonnage output possible. Continuous pouring is not unusual in nonferrous foundry practice, as the comparatively low melting point of the metals used and the small capacity of melting units practically forces the adoption of some plan whereby metal may be cast at frequent intervals, as soon as it reaches pouring temperature. However, in its system of removing the castings from the molding floor the Aluminum Manufactures, Inc., has ventured into fields of plant design which heretofore have been unique to establishments practicing continuous or straight line assembly such as automobile or tractor plants.

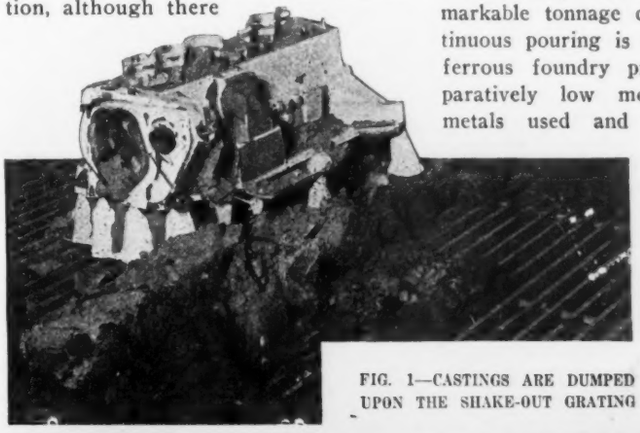


FIG. 1—CASTINGS ARE DUMPED UPON THE SHAKE-OUT GRATING

The backbone of the entire plant design in the Detroit foundry is a continuous slow-moving conveyor which carries the castings to the cleaning room as soon as they are shaken out. This conveyor extends through the center of the main foundry floor and across the entrance end of the cleaning room. The conveyor consists of a series of 18-inch by 4-foot steel plates affixed closely together on an endless belt. The plates form a continuous platform that travels along flush with the floor at the rate of 20 feet per minute. This slow speed permits the conveyor to be crossed at will, even by workmen pushing wheelbarrows of material. Further it may be used as a smooth-paved path, whereon trucks may be drawn along the entire length of the foundry, when it is not in actual service carrying rough castings to the cleaning room.

The conveyor is 410 feet long, and as may be noted from Fig. 6, it extends from the end of the molding floor which adjoins the melting room, through the entire length of this portion of the shop and across one end

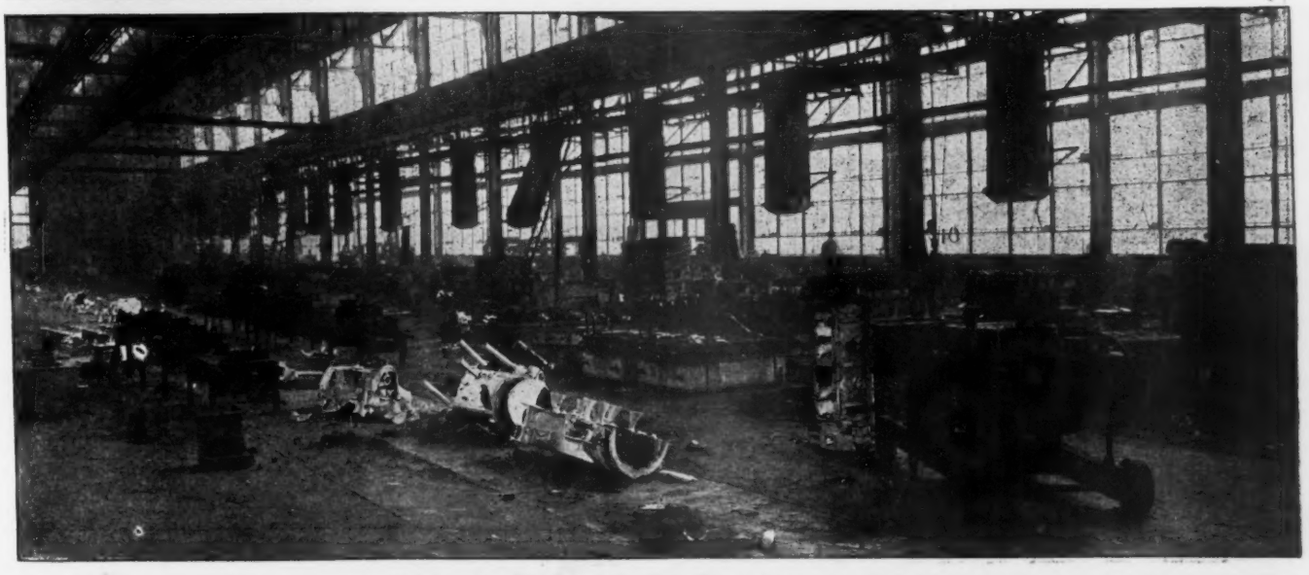
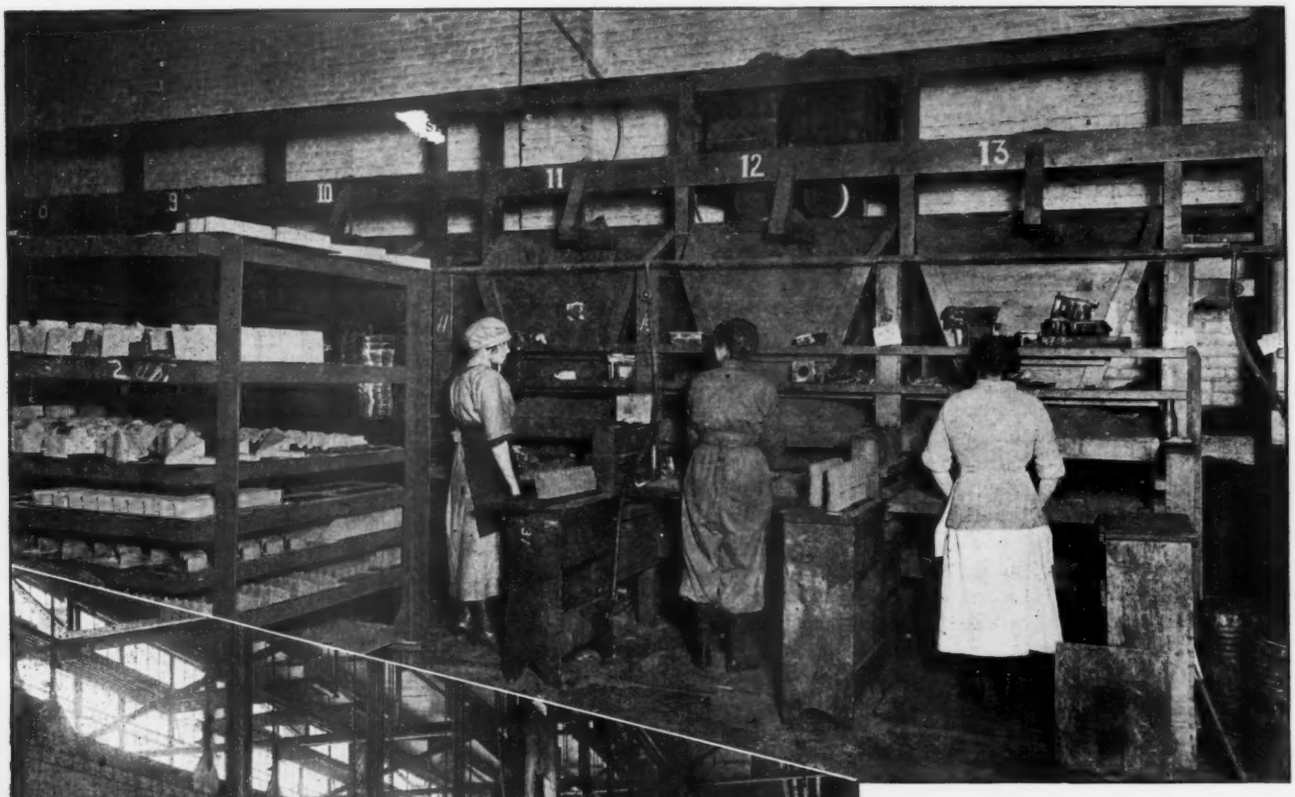


FIG. 2—AFTER THE MOLDING SAND IS REMOVED FROM THE CASTINGS THEY ARE CARRIED TO THE CLEANING ROOM ON A PLATFORM CONVEYOR—NOTE THE SUSPENDED HOPPERS FOR DELIVERING THE MOLDING SAND



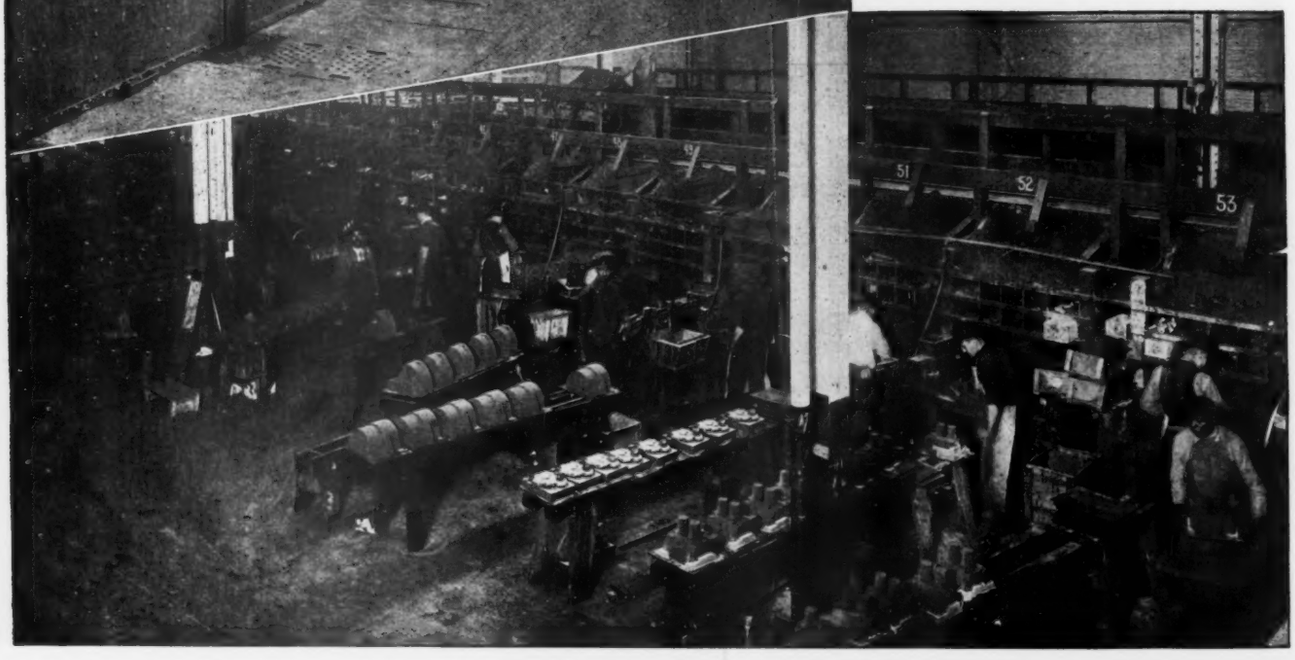


Fig. 3—Sand is served to the coremakers from cars on elevated tracks Fig. 4—A Battery of 14 ovens serve to bake the cores required Fig. 5—There are five lines of coremakers benches—nearly all the cores are made on rollover machines as shown here.

of the cleaning room which is located at right angles to the molding floor at its upper end. As soon as the castings are solidified in the mold they are shaken out over gratings which will be described later, and then are picked up and swung over upon the conveyor. The small hoists which assist at this stage perform this service quickly and then are left free at once to be used in assembling and closing new molds. From the time the castings are deposited upon the conveyor, they no longer cause any concern in the foundry. No confusion which might be incident to their removal by trucks arises, and no crane service is required to assure their reaching the cleaning room in a minimum of time. Covered underground aisles at either side permit easy access to the conveyor mechanism for repairs.

Flanking the castings conveyor on both sides are duplicate underground sand conveyors which remove the sand as it is dropped through gratings in the floor when castings are shaken out. Two duplicate and parallel overhead conveying systems deliver molding sand to the floor where needed. The sand delivery systems are carried on the two lines of columns which support the main roof and separate the central floor from two side bays. Two lines of molding machines, spaced along the two side bays, complete the scheme designed for rapid, continuous molding and pouring.

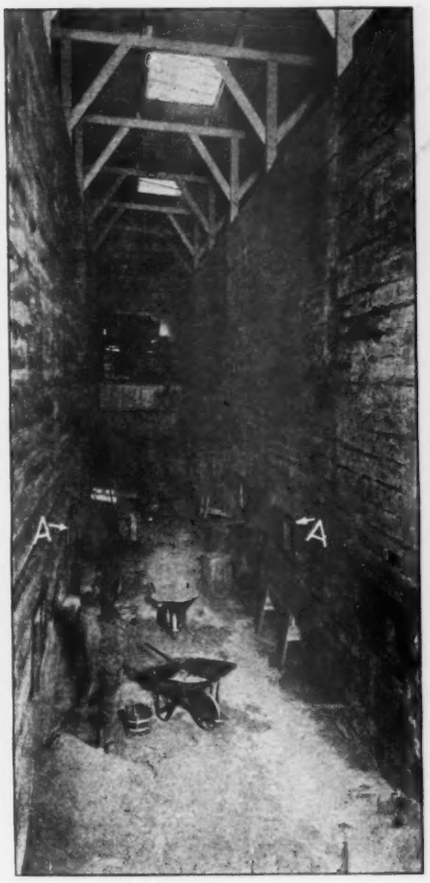


FIG. 7—SPACE BETWEEN THE SAND BINS IN WHICH A CONVEYOR WILL BE INSTALLED

The sand delivery and return systems form an efficient machine for maintaining a constant supply of sand ready for use. From the point where molding sand is brought into the system, a complete cycle of operations is completed, forming a closed circuit which returns the greater part of the sand used again to the mixer. Sand used for nonferrous casting is not burned as is that used in molds for iron, or steel, due to the relatively lower temperature of the molten metal used. For this reason it is possible to use the molding sand repeatedly, and this system which recovers and keeps in continuous activity all the sand which is required effects a real economy. The return system which conveys the sand from under the shake-out grates is capable of conveying 90 tons of sand per hour. The effectiveness of the sand recovery is attested by the fact that with this large volume used, only about 2½ cars of new sand are put in each month.

One grade of molding sand is used on all the work handled in this shop This is unusually light, weighing only 74 pounds per cubic foot when tempered and 99 pounds per cubic foot when packed into the mold.

The system for delivering new sand

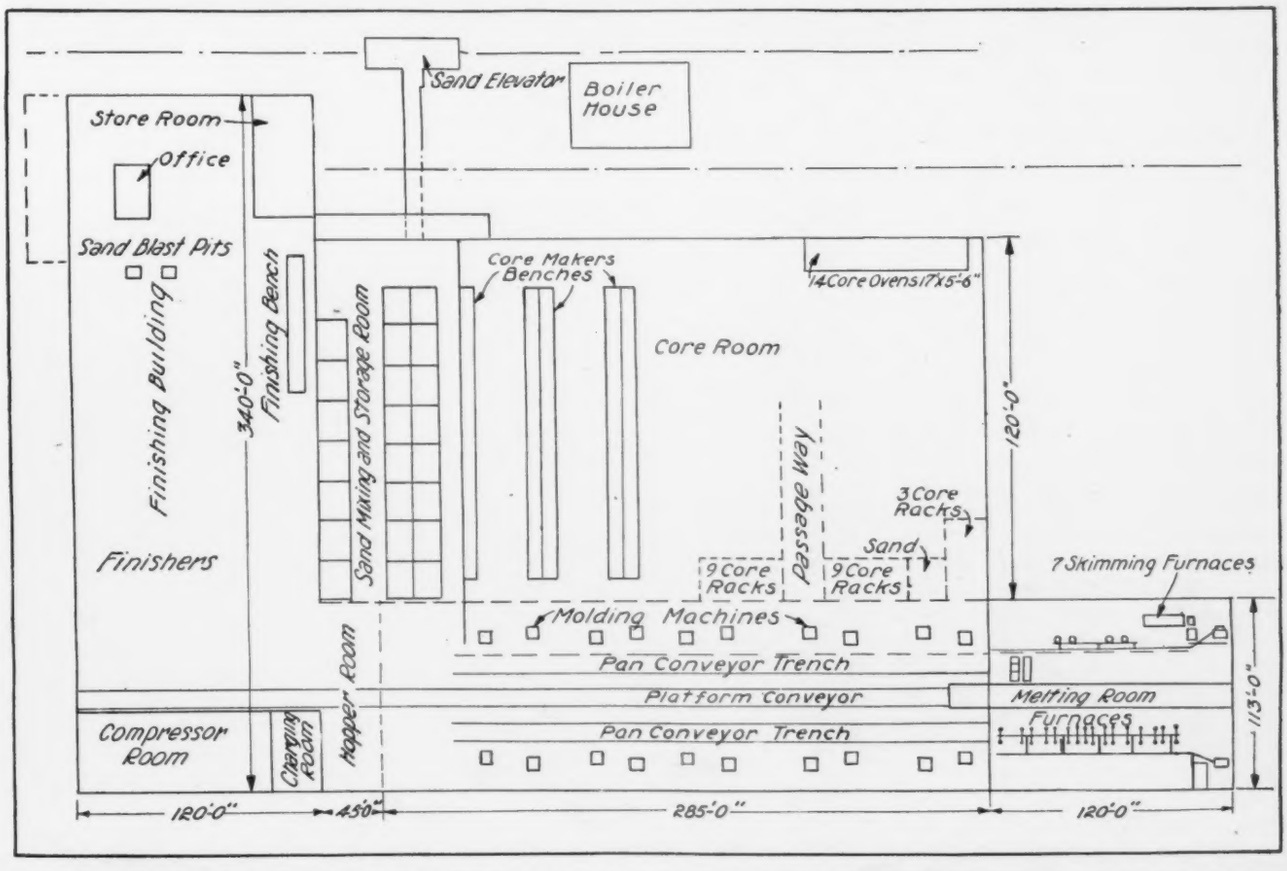


FIG. 6—THE PLAN OF THE FOUNDRY SHOWS A COMPARATIVELY SMALL SPACE DEVOTED TO THE MOLDING DEPARTMENT—A PLATFORM CONVEYOR AND TWO PAN CONVEYORS HANDLE THE CASTINGS AND MOLDING SAND

to the molding floor begins at the screening and revivifying department which is at the opposite end of the molding floor from the melting room. Tempered sand falls from the third floor into one of two hoppers at the receiving end of the delivery conveying systems. Each hopper feeds directly through an oscillating screen upon either one of the two belt conveyors at the opposite sides of the molding floor. The conveyor carries the material along at about 20 feet above the floor level. Intercepting baffles located at intervals scrape the sand from the moving belt into suspended hoppers. These hoppers are 20 x 28 inches in section and terminate in their lower ends in hand operated clamshell gates which are sufficiently high above the molding floor that they do not interfere with the work beneath. The hoppers are so spaced that each stand of molding machines is supplied directly without rehandling the sand. A row of the hoppers may be noted in Fig. 2 which gives a general view of a section of the molding department.

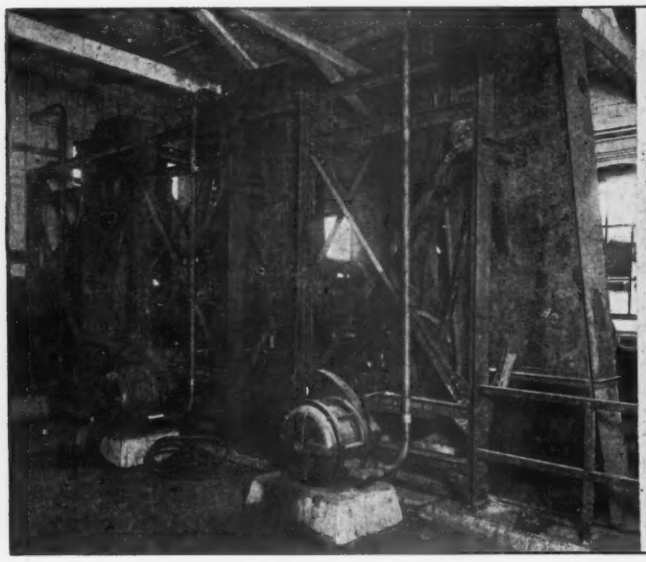
Cars Deliver Core Sand

Sand for the coremaking department is delivered from the sand mixing department through large stationary hoppers, with hand operated gates at the lower ends. From these it is dumped as needed into small dump cars which are run under the gates on tracks laid for that purpose. One of these dump cars placed ready to receive its charge is shown in Fig. 9. The dump cars have four compartments, each of which is large enough to hold sufficient sand to fill a bin at a coremaker's bench. Gaggers and miscellaneous supplies are delivered to the coremakers from an aisle which runs behind the benches and underneath the track on which the core sand is transported. The trackway over which the dump cars operate extends through the core department and has branch lines on elevated trestles placed between each two rows of coremakers' benches and along the wall outside the last row. Cars are pushed along until directly opposite a bin needing sand with the delivery spout of one of the four compartments directly over the bin, when the compartment gate is opened permitting the charge of sand to run down into the core-bench bin. The arrangement of the trackway is illustrated in Fig. 3 which shows a car above a bin.

Thus by the hopper cars in the coreroom and the conveying system in the main molding floor, a constant supply of new sand is assured at all times in both the molding and coremaking departments.

The sand return system on the main molding floor is unusually efficient. As soon as the metal solidifies after pouring, the molds are picked up either by hand or by the small traveling hoists provided at each molding station and dropped upon the gratings covering the sand return conveyors as shown in Fig. 1. These gratings are in duplicate. They are placed on opposite sides of the casting conveyor and extend 285 feet along the full length of the floor, inside the line of the sand delivery conveyors. This arrangement obviates the necessity for carrying the molds more than a few feet before shaking out, and also prevents the confusion which would arise if only one return conveyor system were provided and the molds had to be carried laterally across the foundry floor before shaking out. The convenience of the shake-out system is attested by the fact that in some cases larger molds may be set up directly along side the line of the return conveyor and merely tipped over upon the grating.

The sand which is knocked from the castings falls through the grating and upon a continuous pan belt traveling in the direction of the sand mixing department, where it is delivered into either one of the two revolving screens located in a depression at the end of the molding floor. These screens have a ¾-inch mesh. They are 4½ feet in diameter and 12 feet long. From the delivery end of the screens, the sand is carried by bucket conveyors to the third floor of the sand reclaiming department. Here it is passed through a disintegrator designed by the C. O. Bartlett & Snow Co., Cleveland. The sand is partially tempered with water in the disintegrator to aid in softening the hard packed masses. The reclaimed molding sand falls from the disintegrator into a conveyor which delivers it to one of the hoppers, previously mentioned, which carries it to the delivery conveyors that return it to the main molding floor.



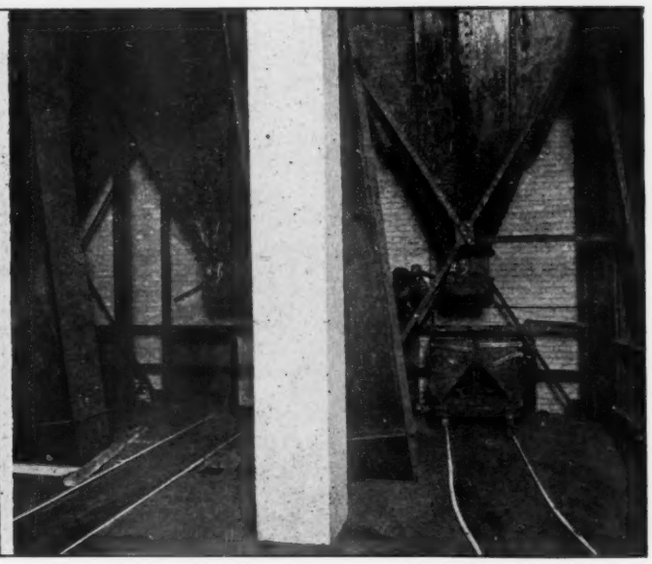


FIG. 8—THREE SAND MIXERS PREPARE ALL OF THE CORE SAND—SAND IS BROUGHT TO THEM IN BUCKET CONVEYORS FIG. 9—SAND IS CARRIED FROM THE MIXER HOPPERS TO THE CORE ROOM IN CARS ON ELEVATED TRACKS

Core Sand Reused

The cores remain in the castings when they are placed on the conveyor to leave the foundry floor. These cores are knocked out by pneumatic chisels over grating in a room adjacent to the main foundry floor and between this floor and the cleaning department. The hard lumps of core sand, together with scrap particles and chills drop through upon a belt conveyor. At the end of the belt conveyor, a bucket elevator receives the

material and carries it to a crusher on the third floor. From the crusher, the sand is dropped into a tilted revolving screen where the fine portion drops through the meshes and is carried by a conveyor to a sand storage bin for reuse. Approximately 50 per cent of the core sand is used again in making the core mixture. The coarse material discharged from the end of the revolving screen is composed of hard, baked lumps of cores, chills and scrap. This falls upon a slowly moving belt conveyor from which the chills and scrap are removed by hand. The company plans to install a magnetic separator to remove the iron chills as the material falls from the revolving screen. The larger lumps are carried forward and again enter the system and are passed through the crusher repeatedly until broken. The chills are sorted and classified for use as needed.

Large Storage Provided

The main sand storage system is ample to care for the large requirements of the establishment. Sand is received in bottom dump railway cars. A large pit hopper is located just outside the main storage department, where the sand is dumped as received, and from thence elevated by a bucket conveyor and carried laterally on a rubber belt conveyor to any one of 23 storage bins. These bins are 14 x 18 feet, and 20 feet deep. They are constructed of reinforced concrete, all under cover, and are arranged in three rows. Aisles are provided between these rows of bins, as shown in Fig. 7. At the present time sand is taken from the hatches shown at *A* and measured in buckets before being wheeled to the mixers. A conveying system has been designed and shortly will be installed that will handle this phase of the transfer automatically. This conveying system will deliver the sand in 30-gallon boxes.

Ten of these boxes will constitute a charge for the core sand mixer. The boxes will be dumped into the mixing hoppers which deliver through elevators to any one of three mixers. The tops of the elevators are shown in Fig. 9. The sand mixers were built by the Standard Sand & Machine Co., Cleveland.

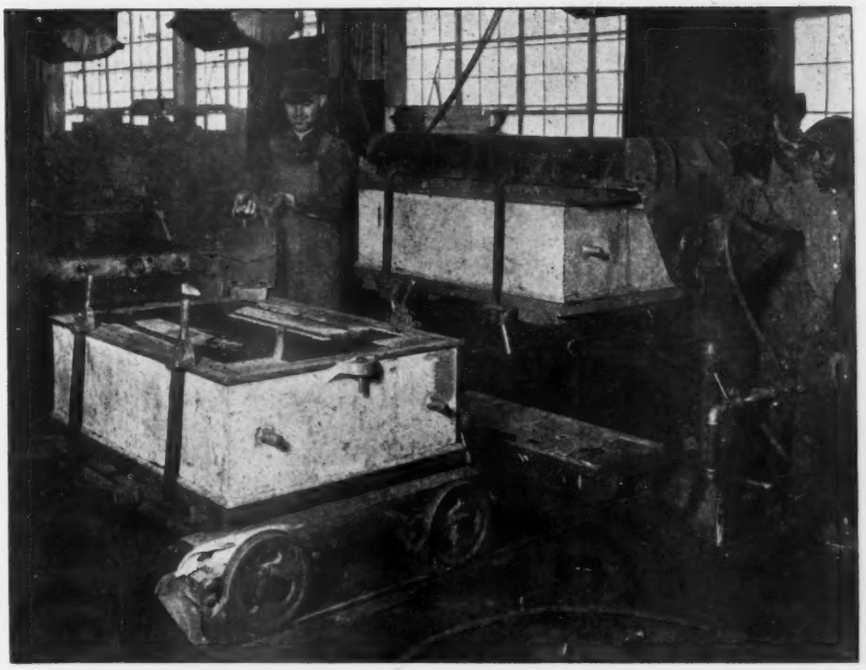


FIG. 11—COPE AND DRAG OF A SIX-CYLINDER GASOLINE ENGINE SHOWING THE ALUMINUM FLASKS WHICH ARE USED THROUGHOUT THE FOUNDRY

Another essential cog in the production machine which has been erected by the Aluminum Manufactures, Inc., is the complete molding equipment employed. The sand delivery, return and casting conveying systems must operate to capacity to yield an adequate return. This obviously would be impossible if molds were not made with sufficient rapidity. The pace set by the well designed handling installations in the main molding department is met by 20 molding machines which are located as indicated in Fig. 6. These machines all are of the jar-ram, rollover type, having been installed by the Cleveland Osborn Mfg. Co., Cleveland; International Molding Machine Co., Chicago, and the Herman Pneumatic Machine Co., Pittsburgh.

Crane Installation

The crane equipment in the molding department, has not been completed. At present a number of I-beam traveling cranes operated from the floor and running lengthwise with the foundry serve the molding floors. These cranes are equipped with chain hoists operated by an air motor. They were supplied by the Ingersoll, Rand Co., New York. Several 2-ton electric traveling cranes operated from cages have been ordered from the Pawling & Harnischfeger Co., Milwaukee. Each of these cranes will serve the cope and drag of one job only. They will be employed on heavy produc-

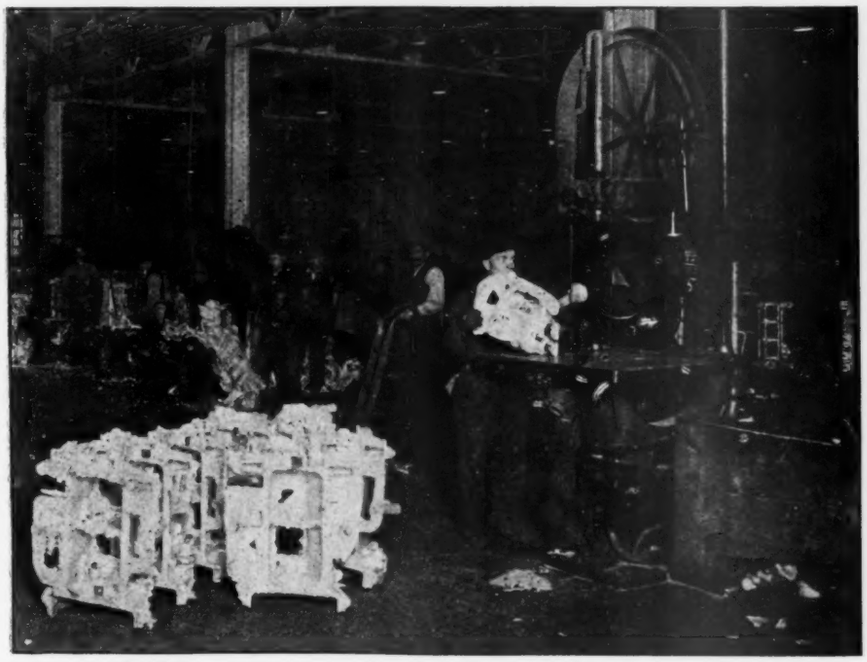


FIG. 10—GATES AND RISERS WHICH CANNOT BE BROKEN OFF WITH PNEUMATIC CHISELS ARE REMOVED BY SAWING

tion work and it is believed that they will be fully occupied with caring for the one molding station.

A minimum of flask equipment is required as the work is molded, poured and shaken out so quickly that few molds are accumulated. Most of the flasks are made of aluminum. These are much lighter in weight than iron flasks, and although more expensive, they may be used until worn out when a large part of their value is recovered by remelting them.

Chills are made of iron, bronze or aluminum. Iron is preferred as chills made of this material may be recovered magnetically in the sand reclaiming department. However, when a number of chills are required in the cope, aluminum castings are used.

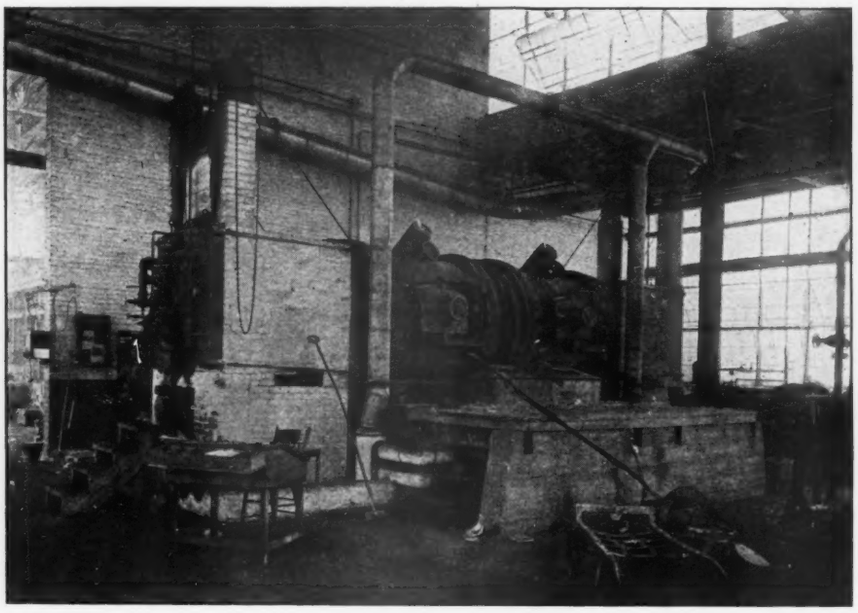


FIG. 12—EXPERIMENTS ARE BEING CONDUCTED IN MELTING ALUMINUM IN A ROTARY REVERBORATORY FURNACE OF A NEW DESIGN

These are lighter than iron chills and are less liable to drop out when the mold is closed.

Machines are used extensively in the coremaking department. Straight draw stripping plate, as well as rollover machines are used depending upon the type of core required. A large part of this machine equipment has been supplied by the Grimes Molding Machine Co., Detroit; International Molding Machine Co. and Henry E. Pridmore, Chicago. Lighter core work is handled on benches, similar to those shown in Fig. 3. These are adjustable in height to the convenience of the worker. The benches are arranged in five rows, four of the rows alongside the elevated trestles described upon which the sand delivery dump cars are operated and the fifth near the wall, but with the car track separating it from the wall as shown in Fig. 3. The arrangement of benches may be noted in Fig. 5. It also may be noted that the core department which is larger than the entire main foundry floor is arranged directly alongside so that the cores do not have to be carried a great distance from the coreracks to the molds.

Three standard core sand mixtures are used, depending upon the destined purpose for which the cores are intended. One of these requires an oil binder while the other two are made with a compound. The oil core is used on small, light work. Racks are employed upon which the cores are placed for transfer to the ovens. Racks are conveyed to the ovens by electric trucks made by the Elwell-Parker Electric Co., Cleveland. Fourteen oil-fired core ovens are arranged in a single row along the outside wall of the core room, furnish ample drying capacity for the large number of cores required in the company's automobile casting work. These ovens are 6 x 16 feet and 7½ feet high. Full pyrometer control is maintained. Upon removal from the ovens, the cores are cleaned and finished where such operations are required and then are placed in working storage or delivered to the molding floor direct. Storage capacity is provided for one day's core requirements. Cores are delivered to the molders on platform stands, which are elevated sufficiently above the floor to enable the molders to lift them without stooping. These stands, some of which may be seen in Fig. 2 are provided with handles at the ends to enable two men to lift and carry them without any difficulty.

The cleaning department measures up well with the remainder of the plant in equipment and efficiency. The cleaning room stretches across at right angles to the end of the molding floor. Castings which are placed on the traveling conveyor in the molding department are lifted off at the entrance to the hopper room which separates this department from the cleaning room. Here the cores are knocked out as has been mentioned, and the castings then are carried into the cleaning room.

Gates, risers and fins are cut off with pneumatic chisels or are sawed off on band saws similar to the one shown in the foreground of Fig. 10. The aluminum is poured at such a low temperature, as has been stated, that little sand is burned on. For this reason two small sandblast units supplied by the American Foundry Equipment Co., New York, are sufficient to clean all those castings which require this operation.

The melting requirements of this large establishment are amply met by a most complete furnace and handling installation. Metal is received in the melting department in the form of pigs or as scrap. Effort is made to confine the work in the foundry to two different alloys but at times several different alloys are made. Obviously it is necessary to keep the scrap from the several alloys separate. Scrap is melted directly with new pig metal for casting, except that which is purchased from outside sources and scrap gates and risers which are likely to contain oxides. These are remelted and cast into pigs before the metal is used in castings. The outside scrap is melted and cast into pigs in order to obtain a fair average sample for analysis in the works laboratory which is maintained by the company at the Detroit foundry to control all metallurgical operations. This method of obtaining an average sample is the only feasible one where the scrap is from indeterminate sources and may be made up of a number of various alloys. A charge contains 30 per cent scrap and the remainder new metal.

For handling the scrap to be remelted, seven furnaces are located in one corner of the melting department. Some of the pig metal molds may be seen in the foreground of Fig. 13. Two rows of melting furnaces also may be seen in this illustration. These furnaces are all of the hand tilting type. They are oil-fired, and are equipped with burners designed by the company. These burners will burn oil as heavy as

24 to 26 Baume. Forty-four of the furnaces are placed and being installed. Each has a capacity of 300 pounds of metal an hour.

Temperature control is important in melting and pouring aluminum. If the metal becomes overheated it is injured, and it should be poured at as low a temperature as possible. For these reasons every furnace is equipped with a thermocouple of a pyrometer, which is suspended from above and hangs down into the molten bath of metal. These thermocouples are protected by metal tubes and do not come in direct contact with the metal itself. The temperature of the metal again is measured in the ladle by a pyrometer as it is carried from the melting room to the molding department. This temperature is taken with a bare thermocouple. The protecting tube is not used, as a longer time would be required for the thermocouple to reach the same temperature as the metal if it were not in direct contact with the molten mass. All the thermocouples are of the type having one element as a wire enclosed in a tube of the other element, the two being joined together at the end. This rugged construction is especially desirable in the couples used without protecting coverings to measure the temperature in the ladles. The thermocouples are connected to indicating pyrometers through selective switches which allow only one couple to be connected with an indicating instrument at a time. The pyrometer outfit was made by the Wilson-Maeulen Co., New York.

The company also has a revolving regenerative-type furnace which still is in the experimental stage. This furnace, shown in Fig. 12, is oil-fired from both ends. The air to be heated is forced into the bottom of the regenerators through the large pipes shown extending down the front of the furnace. The body of the furnace consists of two revolving drums lined with fire brick and clay. These drums, which are motor-driven, revolve independently. They are each 5½ feet in diameter and 7 feet long. The metal in one is heated for pouring by the hot flame coming directly into it and passing through the other compartment. When the metal is ready to pour, this side of the furnace is revolved so that the pouring spout shown at the top of the drum is turned down to allow the metal to run out. The first chamber then is recharged and the flame then is reversed so that the hottest part strikes the metal in the other chamber, while the new metal charged into the side from which the metal was poured is heated by the gases after they have passed the first chamber. These gases then go through the regenerator chambers on the one side to heat them for regenerating the air which will come through them on the next reversal. Metal is charged through the doors shown at the front of the furnace. Each compartment holds from 1000 to 1200 pounds of metal and will melt two charges an hour. It is hoped that this furnace will effect a saving in fuel, and reduce the amount of labor required owing to the larger charges. Metal is now carried from the furnace room to the molding floor in tilting ladles of 1000 pounds capacity each. Additional ladles holding approximately 1500 pounds of aluminum will be procured. The ladles are carried through the center of the foundry on two monorails by electric, cage-operated carriers, supplied by the Sprague Electric Works of the General Electric Co., New York. A portion of the monorail is shown in the upper left hand corner of Fig. 2. The metal may be poured from the ladles into crucibles for casting, or the ladle may be transferred to one of the floor cranes and the metal cast direct.

The general design and layout of the foundry is conducive in every way to the best possible efficiency in operation. A noteworthy feature is the comparatively small area occupied by the molding department as compared to the entire plant as may be noted from Fig. 6. This is made possible by the uniform flow of sand and molten metal into this department, and the rapid and convenient removal of the completed castings and the used sand, scrap and cores. The metal is carried from the furnace room to the molding floor, is cast and the castings and scrap move along out of the foundry and to the cleaning room, while the continuous supply of sand coming in from the opposite direction, and the uninterrupted supply of cores delivered from the adjacent coreroom assist in keeping the molding machines engaged to capacity at all times. During the entire sequence of operations, the pouring floor is occupied only for a short period.

The entire building which houses all the operations of molding, coremaking, melting, pouring and cleaning together with ample storage capacity at all stages is only 340 x 570 feet over all. It is of reinforced concrete construction throughout with large areas of glass in steel sash which assures a plentiful supply of light and free ventilation. Ventilation is further augmented by the monitor-type roof construction. The steel sash used all was made by the Detroit Steel Products Co., Detroit. Artificial illumination is provided by a large number of 600 candlepower nitrogen filled lamps which operate at 30 volts. Each lamp is provided with its own transformer for stepping-down the line voltage to that required.

The floor construction varies with the different departments. The floor in the molding room is concrete, while that of the melting department is brick and the cleaning department floor is made of wood block.

FIG. 13—A NUMBER OF SMALL FURNACES ARE EMPLOYED FOR MELTING THE ALUMINUM—30 PER CENT OF THE MIXTURE IS SCRAP METAL

How and Why in Brass Founding

By Charles Vickers

Mixing Brass, Antimony and Lead

We would like to know whether it is possible to make an intimate mixture of brass, antimony and lead in the proportions of brass 2 parts, antimony 14 parts and lead 84 parts. We wish to make a babbitt metal of this analysis.

No difficulty should be encountered in making the mixture stated. The brass first should be melted, the antimony gradually added, then the lead. It might be possible to dissolve the brass without melting it first, if it was in thin strips and was introduced to an alloy of about half lead and half antimony, made by first melting part of the lead to a red heat, dissolving the antimony, then adding the brass strip, after which the mixture is cooled by adding the balance of the lead.

We suggest, however, that strip copper be used in place of the brass using about 1 per cent. The zinc in the brass will spoil the babbitt as it will cause it to dross badly and much metal will be lost. Never allow any zinc to get into either lead base or tin base babbitt metals. A better alloy is the following: Tin, 5 per cent; antimony, 15 per cent, and lead, 80 per cent.

Making Nickel Babbitt

We will greatly appreciate any information you may be able to give us regarding the composition of nickel babbitt.

The name *nickel babbitt* does not always indicate that the alloy so designated contains nickel, as the effect of nickel on babbitts is similar to that of copper. As a matter of fact many such alloys contain no nickel. The analysis of one "Genuine nickel babbitt" follows: Tin, 90.62 per cent; lead, 0.18 per cent; copper, 4.28 per cent; antimony, 4.76 per cent; and iron, 0.12 per cent. In this case nickel is conspicuous by its absence. A nickel babbitt can be made as follows: Copper, 4 per cent; nickel, 0.5 per cent; antimony, 10 per cent; and tin, 85.50 per cent. To make the babbitt, melt the copper, nickel and antimony together in a crucible. The copper and the nickel are charged together, covered with charcoal, and when melted the antimony is added gradually in order not to chill the molten copper and nickel. To every 4 pounds of copper add ½-pound of nickel, and when melted add 10 pounds of antimony, and when all is liquid add 14½ pounds of tin to produce a hardener that will melt easily in the bath of molten tin comprising the balance of the alloy. This amount of tin will be 71 pounds, and 29 pounds of the ingoted hardener are added making 100 pounds of nickel babbitt. The copper, nickel and antimony mixture in the crucible can be added while liquid to 71 pounds of molten tin, or the tin, can be added to the molten alloy of antimony, copper and nickel, according to which method is considered best, under the circumstances.

Lime Resisting Bearings

We have been asked to furnish bearings that will resist the action of milk of lime. These bearings work in a pump which pumps the milk of lime. Any suggestions in regard to the alloy to use and approximately how long it will wear will be appreciated.

The following alloy will be suitable for the purpose outlined. Copper 76 per cent; lead, 15 per cent; tin, 7 per cent; nickel 2 per cent. Charge the copper and the nickel at the same time and melt both together, then add the tin, and lastly the lead. Stir the alloy thoroughly before pouring and stir at intervals after every three molds have been poured.

Regarding the length of time the bearings can be expected to wear, no opinion can be rendered as there are so many unknown variables. If the milk of lime contains grit which can work into the bearings, naturally they will have a short life compared to the length of time they would last in other service, where this solution is not present.

Facings for Aluminum

Is it advisable to use a close sand facing in molds for aluminum match plates?

A *close* facing should not be used for aluminum; the sand should be free venting so the steam generated can pass away without passing through the liquid metal. The sand can be fine and at the same time the opposite of *close*.

Molten Covering for Brass in the Furnace

We understand that broken glass is frequently used as a flux, or purifyer in melting red and yellow brass for plumbing supplies, and as we have had no experience with this material, we would like to be informed just what its value may be in connection with the melting of metals.

Broken glass is neither a flux nor a purifier of brass and kindred alloys. It acts simply as a covering for the brass, and protects the molten metal from the furnace gases which otherwise would be absorbed by the metal and would produce pinholes in the castings.

The same effect can be obtained by the use of a mixture of sand, lime and soda ash; also by a mixture of two parts line and one par fluorspar. These substances melt and float on the surface of the metal, and act the same as a cover to the crucible. When ready to pour, the covering if thin and liquid may be thickened by adding lime or sand, and then can be skimmed off. The covering may be left on the metal and be easily held from entering the molds by the use of a skimmer. The latter probably is the better practice.

Casting Zinc Ingots

We would like to obtain information in regard to the melting and casting of zinc for rolling mill purposes. We find the ingots we make crack and break on rolling. Any information you may be able to give us will be appreciated.

Zinc for rolling is formed into slabs by being cast in flat open iron molds. The metal must be poured rapidly and in an even stream and after the molds are filled the slab is skimmed to remove the oxide that may have formed on the surface of the metal. The metal must not be poured into cold molds, and probably the difficulty in the present case is due to this practice. The casting table is heated by water to a temperature around 200 degrees Fahr., while the slabs are being cast. Before being rolled the slabs must be heated and the temperature ranges from 250 to 350 degrees Fahr. Zinc will not roll when too cool, and it is necessary to use a good grade of zinc as impurities affect the rolling qualities of the metal adversely.

Spiegeleisen Used in Steel Making

This Alloy With Lower Manganese Contents Supplants Ferromanganese in Some Cases—Owing to the Greater Amount Required it is Necessary to Melt it Before Adding it to the Steel

BY HENRY D. HUBBARD

SPIEGELEISEN was the first manganese alloy employed, about 60 years ago, for deoxidizing steel made by the bessemer process and later in 1865 for steel made in the open-hearth furnace. The name spiegeleisen was that of a white manganiferous pig iron made in Prussia containing from 7 to 8 per cent of manganese. Irons richer in manganese were made from time to time in the years which followed, as they were found to be desirable. But the same name contracted to *spiegel* in the shop, was applied to all such irons up to those containing over 20 per cent of manganese. To irons containing more than 20 per cent manganese the name of ferromanganese was given when they were first made, about 1870. As time went on richer and richer manganese alloys were made until our present standard of 80 per cent alloy came into general use about 1880. As ferromanganese became richer in manganese so did the irons included under the name of spiegel and now the dividing line between spiegel and ferromanganese may be fairly taken at 40 per cent. All richer alloys are called ferromanganese and all of 40 per cent manganese or less are called spiegel.

A more condensed form of manganese has several advantages. Because of this ferromanganese became the popular and almost universal form for adding the element to the molten metal. The advantages of a more condensed form of manganese lie in the smaller weight to be handled which renders preheating and premelting unnecessary. At prewar prices it is perhaps the cheapest form of manganese as well. It is brittle, enabling it to be easily broken to size when desired. Then for soft or low-carbon steel there is the important additional advantage of its high ratio of manganese to carbon, about 12 to 1. This favors greatly the making of such steels, in that the carbon content can be kept down while an ample amount of manganese is added. When more carbon is needed, in the harder steels, than the ferromanganese contains it is provided by adding pig iron, or molten crude iron, or carbon in the form of coke or coal.

There has never been a doubt as to the suitability of spiegel for making the higher carbon steels of good quality. Its use requires no particular care, provided that it be melted or heated so as not to cool the metal beyond a permissible amount. When it was supplanted this was done for the reasons already given.

The United States has large domestic resources of ores suitable for the manufacture of spiegeleisen, and of intermediate grades of ferromanganese, containing 70, 60 and 50 per cent of manganese respectively. This being the case it is, therefore, desirable to ascertain to what extent it would be possible to utilize a greater quantity of spiegel and of intermediate grades of ferromanganese.

The following is an example of how spiegeleisen was adapted to the requirements of a steel company. A spiegel mixture has been used exclusively by this company for a number of years for steels containing over 0.30 per cent carbon. The alloy is added molten. A mixture of standard 20 per cent spiegeleisen, pig iron and, in some cases, ferrosilicon is made up, so that the molten alloy will exactly satisfy the requirements of the steel for carbon, silicon and manganese. The carbon in the bath is worked down to 0.15 per cent and the residual manganese averages 0.17 per cent at tapping out time. The manganese loss in the cupola and ladle is 30 per cent by weight.

The finished steel is fairly uniform in quality, and for steel above 0.30 per cent carbon this company considers it the most effective method of adding manganese. Test samples of finished steel are taken after pouring the first ingot and again near the end of the teeming. These samples are almost identical in manganese and other constituents.

This company claims to be the first to use molten spiegel in open-hearth steel but several other plants are now using it in the same way.

It seems at least possible that steel lower than 0.30 per cent carbon may be satisfactorily made by means of this practice by using a higher manganese spiegel mixture. On the basis of the method used by this company for computing their mixture, the following table has been prepared to show how, from the chemical standpoint, steel containing 0.20 per cent carbon can be made from various spiegel mixtures:

Per cent carbon in bath	Lbs. alloy per ton of steel	Per cent Mn. in alloy	Per cent loss Mn.	Per cent carbon in alloy
.08	56.0	18.85	30	4.8
.10	43.2	25.60	33	5.2
.12	32.5	36.10	37	5.5
.15	18.7	66.00	40	6.0

From this table, it is evident that with the use of a 66 per cent mixture, the heats could be tapped at 0.15 per cent carbon. If carbon were 0.10 per cent at tapping a 25.60 per cent manganese mixture could be used. It would of course take somewhat longer to work the carbon down from 0.15 to 0.10 per cent and the output of a given furnace per day would be decreased proportionately to the increased time required.

Form Foundry Association in Connecticut

The Connecticut Foundrymen's association recently has been formed as an organization which will hold monthly meetings independently of the New England Foundrymen's association. F. W. Stickle, of the Capital Foundry Co., Hartford, Conn., is the first president. At the recent meeting of the New England Foundrymen's association in Boston, Mr. Stickle explained the position of the new association in Connecticut. He said, "We in no way conflict or compete with the older organization. Our purpose is principally the handling of detail matters in connection with our foundry business. Our members do not intend to discontinue their membership in the larger organization."

Anti-friction alloys containing graphite are made by impregnating molten metal with graphite under pressure. The graphite acts as a lubricant. The same result can be obtained by first producing a plastic bronze and then working the graphite in and afterwards extruding the mixture into the desired shapes, which may be a section suitable for a bearing, from which the bearings are cut off. The plastic condition is obtained by means of a reaction that occurs between copper, lead and phosphorus.

Castings For Ship Construction-XVII

Small Single Screw Vessels Require a Different Type of Sloped Stern Frame — Methods of Construction, Involving Permanent or More Easily Built Patterns are Explained

BY BEN SHAW AND JAMES EDGAR

STERN frames for single-screw ships differ slightly from the type previously described. It will be noted from the accompanying illustration that this frame has a slope on the bottom trough toward the bow of the boat. This minimizes the risk of breaking the casting for even though the vessel may be trimmed by the stern, the stern frame casting will be clear at the lowest point along the keel. The casting is a combined shaft bracket and stern frame. On each end of the bracket

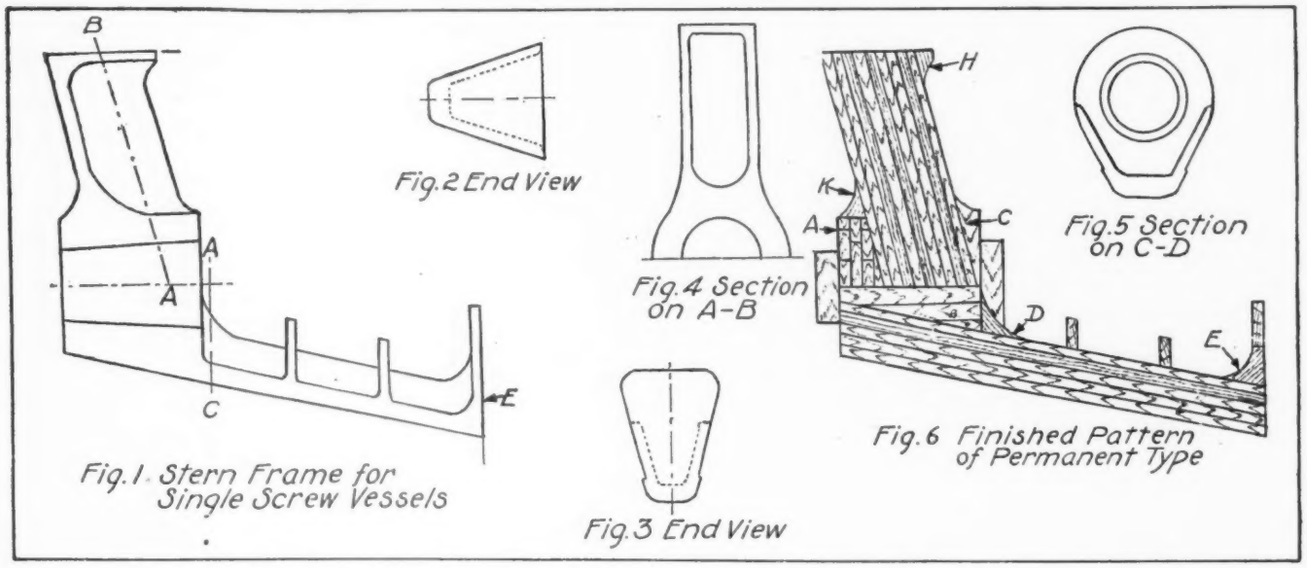


FIG. 1—STERN FRAME CASTING FOR SINGLE SCREW VESSEL FIG. 2—VIEW AT UPPER END OF STERN FRAME FIG. 3—VIEW AT FORWARD END OF STERN FRAME FIG. 4—SECTION ON *A-B*, OF FIG. 1 FIG. 5—SECTION ON *C-D* FIG. 6—FINISHED PERMANENT TYPE PATTERN

are flat flange pieces to which the wrought iron parts are joined. Fig. 1 is a section through the center of the arms. The casting is illustrated as it will be in the ship. While the flange at *E* is raised above the trough, that at *B* is practically the same height. The section on *AB*, Fig. 4, is given to show how a large fillet is formed inside the trough at the junction with the boss thus graduating the metal from the boss to the arm. The bottom arm joins the face of the arm as shown in Fig. 5, and the bottom metal simply forms an extra thickness on the boss.

This is a rather difficult pattern to make. It would not be practical to box both arms and core out the troughs, because of the labor involved in the patternshop. The problem which the patternmaker has to solve is how to construct the pattern so as to give the maximum strength. If the arms are not built onto the barrel, they must be so securely fastened that they will not sag when the pattern is handled. Fig. 6 shows a pattern constructed with the arms built onto the barrel, the lagging of the arms forming also the lagging of the barrel. Fig. 7 shows the other method of construction, wherein the barrel is built independently of the arms, and the arms are built against it, and supported by thick battens which are shown by the dotted lines. These battens preferably should be made of hard wood. The latter method of affixing the arms is much cheaper, and provided only one casting is required, quite satisfactory. However, if the frame is for a standard type of ship and consequently the pattern will be used many times, it cannot be too strongly made. The better form of pattern will be described first.

Building the Durable Type

The job as usual should be set out on the floor or building board from the templet supplied by the mold loft, and the usual contraction added. Figs. 8 and 9 show the best form of barrel. The frame should be about 4 inches less in diameter than the finished barrel. It may be thought that this will make an excessively heavy pattern, and that less thickness of lagging would suffice, but it must be remembered that the arms are long, the thickness of the metal of the arms will probably be not less than 2 inches, and to reduce the lagging from 2 inches to 1 inch when it reaches the barrel would not be conducive to strength. Further, there would be no saving of lumber as the excess would be removed. In the illustrations the frame is not shown made of segments, but of two thicknesses crossed, a form adopted because of the number of notches that will be cut out for longitudinal stays. However, the segmental method could be used, the segments being kept sufficiently wide for strength, and a tie batten being built on the center line. If cross frames are used they should not be less than 2½ inches thick, and for each half the three should be screwed together and finished. The reason for the number of stays is to make a good bearing for the lagging, a portion of which will not rest on the frame at all, but on three stays alone. The skeleton half barrels should be doweled together, before the one half is set in position on the floor to begin

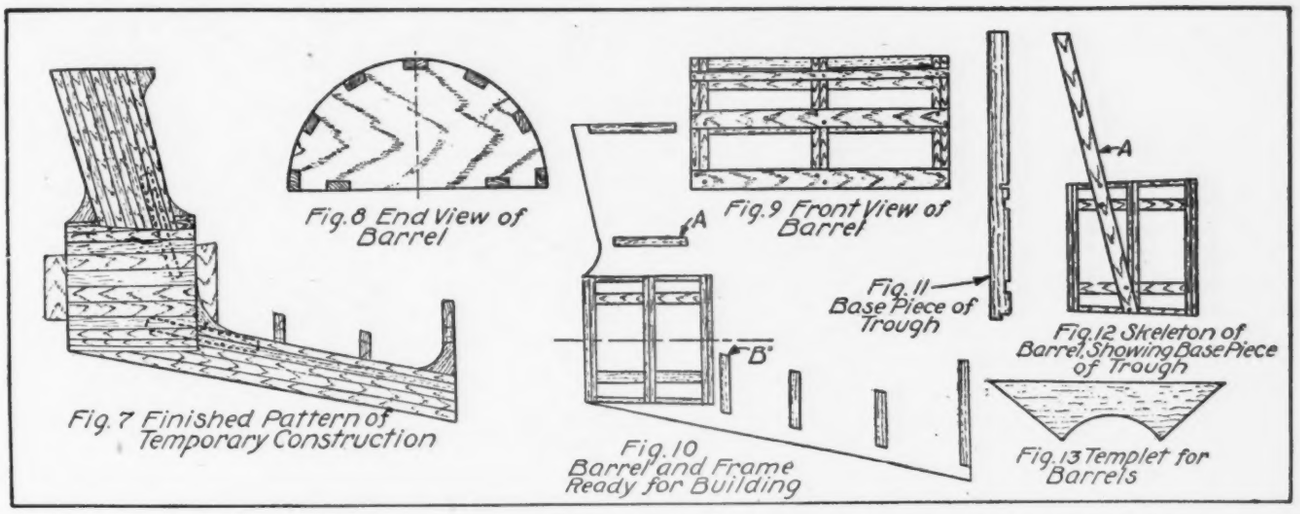


Fig. 8 End View of Barrel
Fig. 9 Front View of Barrel
A
Fig. 11 Base Piece of Trough
A
Fig. 12 Skeleton of Barrel, Showing Base Piece of Trough
Fig. 7 Finished Pattern of Temporary Construction
B
Fig. 10 Barrel and Frame Ready for Building
Fig. 13 Templet for Barrels

FIG. 7—FINISHED PATTERN OF TEMPORARY CONSTRUCTION WITH THE ARMS BUTTED-UP TO THE BARREL FIG. 8—END VIEW OF THE BARREL FIG. 9—FRONT VIEW OF THE BARREL FIG. 10—BARREL AND FRAME READY FOR BUILDING FIG. 11—BASE PIECE OF TROUGH NOTCHED FOR FITTING FIG. 12—SECTION OF THE BARREL SHOWING THE BASE PIECE OF THE TROUGH FIG. 13—TEMPLET FOR THE BARREL

building the pattern. Then to strengthen it, in addition to the ribs or stiffeners inside the trough, which will serve the purpose of a frame, additional frame support will have to be used, as shown in Fig. 10, *A* and *B*. The shape at any section of the trough for these additional frames is easily determined. Lines representing the top and bottom of the trough are laid out, and then the width at any section is obtained. The depth may be found from the floor view corresponding to Fig. 1. As the frames will be removed afterwards and the ribs likewise must be left loose for the molder, care must be taken when building that no glue gets on the edges. Each piece of lagging, after it has been bedded on the frame should be finished on the inside, as the arms are being removed from the barrel, and it will be difficult to do much finishing later. When the half barrel and the frame are screwed to the floor, the arms may be built, beginning with the top arm. In the illustration, all the top stays have been left off to make it less complicated. A good base for the top arm is formed by screwing the joint piece *A*, Fig. 12, across the barrel. It should be grooved over the stays and made of hard wood if possible. Fig. 11 shows it notched and ready to be screwed down. This is a much superior method to butting it against the barrel and relying on a pocket screw.

The lagging which should be about 2 inches wide now may be built. It will be necessary to cut each piece separately and although no joints are shown in Fig. 6, it may be advisable, in order

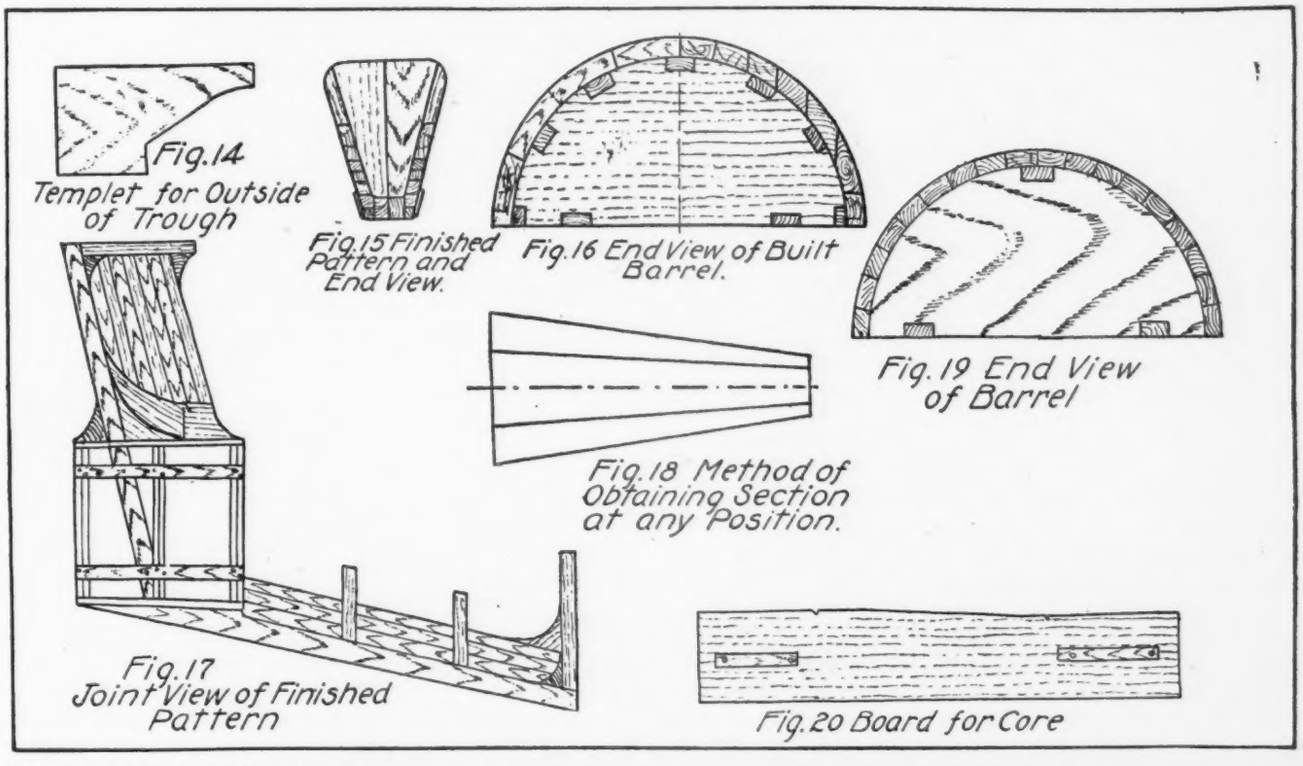


Fig. 14 Templet for Outside of Trough
Fig. 15 Finished Pattern and End View.
Fig. 16 End View of Built Barrel.
Fig. 19 End View of Barrel
Fig. 18 Method of Obtaining Section at any Position.
Fig. 17 Joint View of Finished Pattern
Fig. 20 Board for Core

FIG. 14—TEMPLET FOR OUTSIDE OF THE TROUGH FIG. 15—END VIEW OF THE FINISHED PATTERN FIG. 16—END VIEW OF THE BUILT-UP BARREL FIG. 17—JOINT VIEW OF THE FINISHED PATTERN FIG. 18—METHOD OF OBTAINING SECTION AT ANY POSITION FIG. 19—END VIEW OF THE BARREL FIG. 20—BOARD FOR FORMING THE CORE

to save lumber, to make the lagging in two or three short lengths, crossing the joints as in ordinary segmental work. It is well to build the arms to the center of the barrel. If ingenuity is displayed by the craftsman in breaking out lumber, there will be a great saving. Each piece will be a guide when cutting the next piece, and after it has been roughly sawed it may be placed in position, and accurately marked by the use of hermaphrodites, the caliper end resting on a ground while the scriber end marks the timber. Of course the lagging should be well screwed, and there should be sufficient thickness to insure that when the outside is finished the metal will not be thin. The bottom arm is built in a similar fashion to the top arm. However, the base is not grooved onto the frame, but is fitted and made flush with the end of the barrel. The lagging may be made in short lengths as with the top arm.

The barrel now may be completed, as there are parts which have not been covered by the lagging. The part at *A*, Fig. 6, is most easily filled with a segmentally-built piece which can be finished inside and out at the sandpapering machine. But the part *B*, which is wedge-shaped between the two arms, can be filled in with ordinary staves. The piece *C* may be cut from solid timber.

The outside of the pattern will require some finishing and for the purpose, it is better to lift it upon trestles or legs of the same length screwed against the several faces. Planes and spokeshaves will have to be used. The adze is often used on this class of work for roughing off but unless by the expert the practice is not recommended. The best tool for the patternmaker to use in roughing down work is undoubtedly the crank gouge. The knuckles do not knock the timber as when using the ordinary gouge, and it can be used comfortably in any position. The diameter of the barrel may be drawn on the ends and a straightedge may be used from end to end when finishing part of the barrel, but in the portion near the arm fillet, a templet like Fig. 13 had best be used. For the outside of the arms, templets like Fig. 14 are made. The corner pieces, *D*, *E* and *H*, Fig. 6, should not be screwed on until the shape is finished off and a solid block should be fitted for the fillet *K* behind the top arm.

It may be observed from Fig. 15, that the end flange is continued to the inside of the trough metal and carried straight out, a piece being afterwards screwed on at the ends to make it line with the outside of the metal. This is a better method than cutting it from one width of lumber, as it allows greater freedom when building the arm. The thickness which forms the groove on the bottom arm is not shown in Fig. 6 but it presents no difficulty. The barrel as it will appear on the outside face is shown at Fig. 16 and a joint view is shown at Fig. 17. The large fillet at the junction of the top arm with the barrel has still to be made and also the smaller fillets which strengthen the end flange. The latter should be made in three or four parts. These may be fitted first, after which they can be removed and gouged to conform to template. This portion might be made skeleton style allowing the molder to complete the fillet with sand, but no great saving will be effected in the end. The large fillet must be made of solid blocks. The prints on the end of the barrel may be boxed up or made solid, and should be 3 or 4 inches thick. This finishes one-half of the pattern and the other half may be built upon the top of it. A stay may be screwed across the faces of each half, which will bind the arms and the boss. It should be about 1½ inches thick and doweled.

The form of construction illustrated in Fig. 7 is easier. The barrel is lagged as shown in Fig. 19, and not as many stays are needed because the arms will butt against the staves.

The lagging should be closely fitted against the boss and each piece should be pocket-screwed to the boss. Some reliance will have to be placed on the large fillets between the arms and the boss. For this reason, they must be well fitted in segments, and both glued and screwed. The fillets are not shown in the sketch, Fig. 7. However, in this figure, the top battens are indicated by dotted lines. They should be made long, 3 to 4 inches square, and with plenty of taper on both sides and ends. The molder will not remove these but simply will make up the space left by them after the pattern has been drawn from the sand. The inside of the arms will be finished in the same way as for the other style of pattern.

This design lends itself to quick production, because quite apart from getting the lumber ready, men can work independently on each arm. If the foundry was to insist on the arms being cored, which, as has already been said, is unlikely, the methods that it would be necessary to employ have already been described in previous articles. The boss core would be run up with a horizontal board like Fig. 2, and when the fillets have been painted inside the arms the work is ready to be sent to the foundry for molding.

French Foundries in Occupied Areas Resume

An example of the efforts being made again to operate manufacturing establishments in France which suffered from the effects of invasion by the Germans is given in a communication recently received in this country from the management of the metallurgical society of Aubrives and Villerupt. The works of this society are situated at Aubrives, which is in the department of Ardennes in the valley of the Meuse, and at Villerupt, near Longwy in the Meuse-Moselle district. Before the war, the company was engaged actively in manufacturing cast iron pipe for water and gas, waterworks apparatus and accessories for the distribution of water, downcomers, track material, hydraulic pumps and castings.

Owing to their location near the frontier, the plants were in the invaded district at the beginning of hostilities and with the other plant in this region suffered severely during the period of occupation. Immediately following the evacuation by the Germans and the return of the invaded property to its owners the company undertook the work of reconstruction. After considerable work, operation of the Aubrives foundries was resumed. This plant now is producing a fair tonnage and is contributing largely to the rebuilding of the devastated regions by furnishing pipe and accessory equipment for the restoration of the destroyed or damaged water service. At Villerupt the blast furnaces were destroyed during the war and the machinery and other accessories which were not carried off by the Germans were destroyed. The recovery of stolen material has progressed slowly, due to the lack of adequate means of transportation and because of the numerous difficulties inherent in reorganizing the area. In spite of this damage the Villerupt foundries already have been placed in operation. At the time the communication was written the firing of the furnaces was considered only a question of days and it is expected that the society soon will be able to furnish the raw material for both of its foundries in sufficient quantity for normal operation.

The society is planning to enter the export market in competition with pipe foundries which have not suffered from the war and already important orders for track equipment, brake shoes, and other supplies have been received by this company.

Standardizing Foundry Operations

Definite Rules for Every Operation in the Foundry, if Laid Down by an Authority, Result in Improved Production and Lowered Manufacturing Costs — Save Time and Confusion

BY PAUL R. RAMP

FOUNDRY practice intelligently standardized creates a smooth-working, effective organization, and makes it possible for one man with a thorough knowledge of the business to put that knowledge to work in every department simultaneously. This results in castings of better quality, lower production costs, greater production per man and a uniform flow of work through the shop.

In a manufacturing shop a standard practice should be adopted for the performance of each operation connected with the making of a casting. Such a standard should represent the best method for doing the work. There is only one best method, and if it is properly described and the workmen thoroughly instructed, very gratifying results can be expected.

In establishing a standard, quality must come first. Every detail of the work that tends toward a perfect casting must be carefully considered and the material that enters into the job must receive attention. This insures a daily production of castings nearer perfect than when the operations and materials are changed at will, according to the foremen's or workmen's ideas.

The next important item to be considered is the cost of production. In this connection it must be realized the man who is competent to manage a foundry must be competent to create a standard foundry practice that will produce a casting at the lowest cost consistent with quality. His instructions will be along economical lines; they will cover the question of production per man and every unnecessary movement will be cut out.

A standard should be provided for every job in the shop and each one given a number. While this may appear as a great deal of work it is worth all the effort put forth and, in reality, after a number of standards have been established and worked out it is possible to classify the work in such a manner as to use one standard for several different jobs. Take for example a 6-barrel automobile cylinder without crankcase which is being made according to a standard practice. Another cylinder casting, very similar to it, comes into the shop. After the superintendent has gone over this second cylinder he finds that he can write the standard for it as follows:

Standard for molding and casting 6-barrel cylinder pattern No. 1772.

Use standard No. 10 for every operation except as follows: Chaplets over jacket to be 3/16-inch instead of ¼-inch.

Use 6-pencil gates on Nos. 1-2-5 and 6 barrels, and 4-pencil gates on Nos. 3 and 4 barrels instead of 6-pencil gates throughout as in standard No. 10.

The manner in which each detail is described in the instruction sheet is of as much importance as the standard itself. It must be comprehensive and include every item and every movement connected with the work.

Written for the Workmen

In preparing the standards, the terms applied to the various tools, equipment and material must be the same as used by the workmen in the shop in order to avoid any misunderstanding. The division of the items must be made in such a way as to group together several minor operations and bring out the important points. Too much detail will have a tendency to slow up the job and not enough detail will invite carelessness on the part of the workmen and foremen.

He who writes a standard must bear in mind that the workmen are expected to work according to instructions, and if a small item is overlooked on the instruction sheet it will be neglected by the workmen. For this reason it can readily be understood why a standard foundry practice must be written by a competent foundryman.

The following is an example of how this work should be handled and gives an idea how close to the work the foundry superintendent must be in order to make his standard practice a success. These instructions cover the operations necessary to run the cope part of a tractor cylinder mold. Note that almost every detail is taken care of and the instructions must be strictly observed.

Operation No. 1—Drop stripping plate into position, look at telltale to be sure stripping plate has gone down far enough to make the mold full size; brush and blow off pattern and plate.

Operation No. 2—Inspect joint of cope flasks to be used and clean off any sand, clay-wash or paste sticking to it that would prevent it from fitting down to the surface of the plate.

Operation No. 3—Cope-rammers place cope flask on machine by hand.

Operation No. 4—Clamp cope flask to molding machine, to hold it firmly in place while jolting; one clamp on each end of flask.

Operation No. 5—Put gate cores in their proper place and wedge them to keep them from moving; put riser pin in place; put block used to form ram-up opening at the end of pipe core print in position.

Operation No. 6—Riddle three shovels of facing over pattern.

Operation No. 7—Place a total of six 60-penny spikes between barrel core prints; one 60-penny spike at gear end of head-side of water-pipe core print and breather core print. Place five 60-penny spikes between flask bar and wheel housing; two 60-penny spikes in pocket formed by bases, flange and gear end of water pipe. All spikes must be dipped in clay wash.

Operation No. 8—Place six gaggers between water pipe and base flange; four gagers along head-side of water pipe; two gaggers over main body of pattern at wheel-housing end of cylinder; one gagger on joint at gear end core next to water jacket; one gagger on joint at wheel-housing core print next to water jacket. Instructor must see that too much clay wash is not used on the gaggers thus creating wet spots which will result in blow holes.

Operation No. 9—Tuck bars with hands between water pipe and the base flange. This is important to prevent swells at this point, which will not be accepted by the customer.

Operation No. 10—Fill cope flask heaping full of sand.

Operation No. 11—Ram with peaning rammer all around the outside edge of pattern to insure a solid joint.

Operation No. 12—Add enough heap sand to fill the mold heaping full again and jolt the mold 25 times.

Operation No. 13—Ram the surface not directly over the pattern with a butt rammer; ram very lightly over the pattern to prevent blow holes from hard spots in the mold. Instructors must give a practical demonstration of this operation as many times as is necessary to teach the operator.

Operation No. 14—Strike off top of flask with straight edge.

Operation No. 15—Vent all over pattern surface with ⅛-inch wire; use care in doing this not to strike the sides of the water pipe with wire as this will produce a rough spot in the casting.

Operation No. 16—Draw out stops in gate cores; draw out water pipe ram-

ming block; draw out riser pin.

Operation No. 17—Start vibrator and draw pattern through stripping plate. Always start vibrator four seconds before starting the machine to draw the pattern and continue the vibration until the pattern is out of the sand.

Operation No. 18—Release clamps to hold the flask firmly on the machine.

Operation No. 19—Lift mold off of machine with crane and deliver it to the molding floor.

Other Points for Consideration

The instruction sheet for ramming the drag part of this mold is very similar. Where a large production is expected from one pattern equipment, the work of finishing the molds, placing the cores and closing them ready for pouring, must be intelligently divided between the right number of men. In this case about four men would be required to close 100 molds, and a detailed instruction card should be made out covering the work of each man.

With every job the question of defects comes up and this must be standardized in about the same manner. This part of the standard must receive the best thought and study of the foundry superintendent, for there is no reason why defects should continue from day to day if the foremen are on the job, assuming of course that the superintendent is able to supply the correct remedy for each defect.

Following are a few of the defects and remedies that the previously described cylinder is heir to, and the manner in which they are handled:

Scant stock in main bearing bolt-boss flywheel end.

The flywheel housing core must be placed strictly according to the gage. When this core is set in toward the crank-case core too far, it moves the main bearing in and cuts off the stock necessary to form the boss around the stud bolt that holds on the end-bearing cap. This is important and must be watched closely to avoid machine shop scrap.

Scant stock for stud on contact-face corner near manifold.

In applying plumbago to the drag mold the molder is careless and leaves a portion of this material in the corner of the mold. This should always be brushed out clean, as this surplus reduces the stock and changes the radius of the casting at this point, so that there is not enough stock on this corner outside of the stud that is used to bolt the head to the cylinder.

The standard foundry practice if handled by one person makes it impossible for the heads of various departments to place the blame on someone else when their work is not coming out right. An illustration is a case of some buckled crank-case cores, where the core department lost several weeks trying to shift the responsibility for the loss onto the foundry, when all that was the matter was a defective sand mixture. The mixing machine was in bad shape and did not mix thoroughly. Beside too much sand was put through the machine, which resulted in the time allowed for mixing each batch being cut down. This made it necessary to increase the percentage of fine sand to make the cores stand up green. So a core was produced that would not relieve the vent and a large quantity of scrap castings were produced.

If the standard foundry practice had been in working condition the core department would not only have had orders to stop the loss, but would have had at their command the detailed instructions necessary to stop it and could not have spent the company's money trying to hide the cause, until after every remedy offered by the standard had been exhausted.

The core department is a place where the standard practice is needed most of all, and can be established the best if there are many things that can be standardized in the coremaking work that will save time and loss of castings. The standard stops once and for all the arguments that come up between the foundry and the core room. Both must work after a rule laid down by the standard practice. The man who writes it must, therefore, be the master mind which controls the quality and output of the plant. He will not do as well if his standards are submitted to a committee to debate over and alter. If left alone he will work out each job and get the best there is in it.

After a shop has been standardized it is not necessary to worry about someone changing the methods. The main essential is to have some one with courage and executive ability enough to see that the men work according to the rules established.

When the work is not coming out of the shop as it should, the first question to be asked by the management is: Has the work been done according to our standard? The answer nearly always can be: No.

Applicable to Jobbing Shop

It has been suggested that a standard foundry practice can be adopted only in a shop making specialties in large quantities. Some work, such as locomotive, farm implement, air compressor, automobile and similar castings, lend themselves more readily to establishing a standard practice that takes care of every detail and leaves no reasonable excuse for failure than work received in the general jobbing foundry, where only a few pieces are made from each pattern at intervals.

But a standard practice can be established in the jobbing shop with success, and the best way to start it is by standardizing the cupola practice, and the iron mixtures. Then establish standards for facing sand mixtures, core sand mixtures, methods for taking care of flasks, etc.

A standard method of venting molds is important. This item alone is not given the proper thought in the jobbing shop, and can be handled very completely and effectively. A method for ramming large or small molds should be standardized. This is another operation in the jobbing shop that varies and is the cause of a great deal of loss in defective castings.

The pattern departments should be compelled to work according to a standard practice. There are many details connected with pattern work that in the most of our shops are overlooked and cost unnecessary money simply because no one has realized the importance of establishing a standard way for doing the work and insisting upon it being done that way.

Castings Before Pattern is Accepted

A part of a standard foundry practice connected with the production of automobile cylinders specifies that before the pattern department turns over a new cylinder or cylinder-head pattern to the foundry for production, they must make a plaster mold, and a complete set of plaster cores from the new equipment. These must then be assembled in the presence of a foundry representative and all needed corrections must be made before the foundry is allowed to accept the pattern. Then the foundry is expected to furnish two or three castings as samples to the pattern department who must have the same checked up on the layout table and if O. K. present the foundry with a written statement authorizing them to proceed with production. This plan saves the company many dollars, and keeps them out of unpleasant trouble with the customers.

A great many objections can be raised as to the advisability of adopting a standard foundry practice, and a large number of questions asked that one would think it impossible to answer. It must be remembered that standard foundry practice means finding the best method for doing a thing with the means available, then making a record of it and insisting upon its being done that way until some time when it is possible to change the method to advantage.

THE FOUNDRY DATA SHEET, JANUARY 1, 1920

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

DATA ON CHIMNEY DESIGN

By J. G. Mingle

Theoretical Draft of Chimneys

Chimneys are required, in general, for two purposes, viz.:

1—To provide a draft and produce combustion.

2—To carry away gases or the products of combustion.

The first requirement governs the height and the second the area of a chimney.

Draft is the difference in pressure produced by the difference in weight between the hot gases inside the chimney and an equivalent column of outside air. Draft in chimneys is analagous to difference of head in water.

The intensity of draft is measured in inches of water and is determined theoretically by the following formula:

$$D = 0.518\ P_o\ H \left(\frac{1}{T_o} - \frac{1}{T_c}\right)$$

where D = intensity of theoretical draft in inches of water,

H = height of chimney in feet,

P_o = observed atmospheric pressure in pounds per square inch,

T_o = absolute temperature of outside air in degrees Fahr.,

T_c = absolute temperature of chimney gases in degrees Fahr.

For convenience let

$$K = 0.518\ P_o \left(\frac{1}{T_o} - \frac{1}{T_c}\right)$$

Then D = K H.

Assuming an observed atmospheric pressure of 14.7 pounds per square inch, Fig. 1 gives the values of K for various chimney gas temperatures with the observed outside air temperatures as indicated.

(*Continued on Data Sheet No.* 316)

DATA ON CHIMNEY DESIGN

By J. G. Mingle

(*Continued from Data Sheet No.* 315)

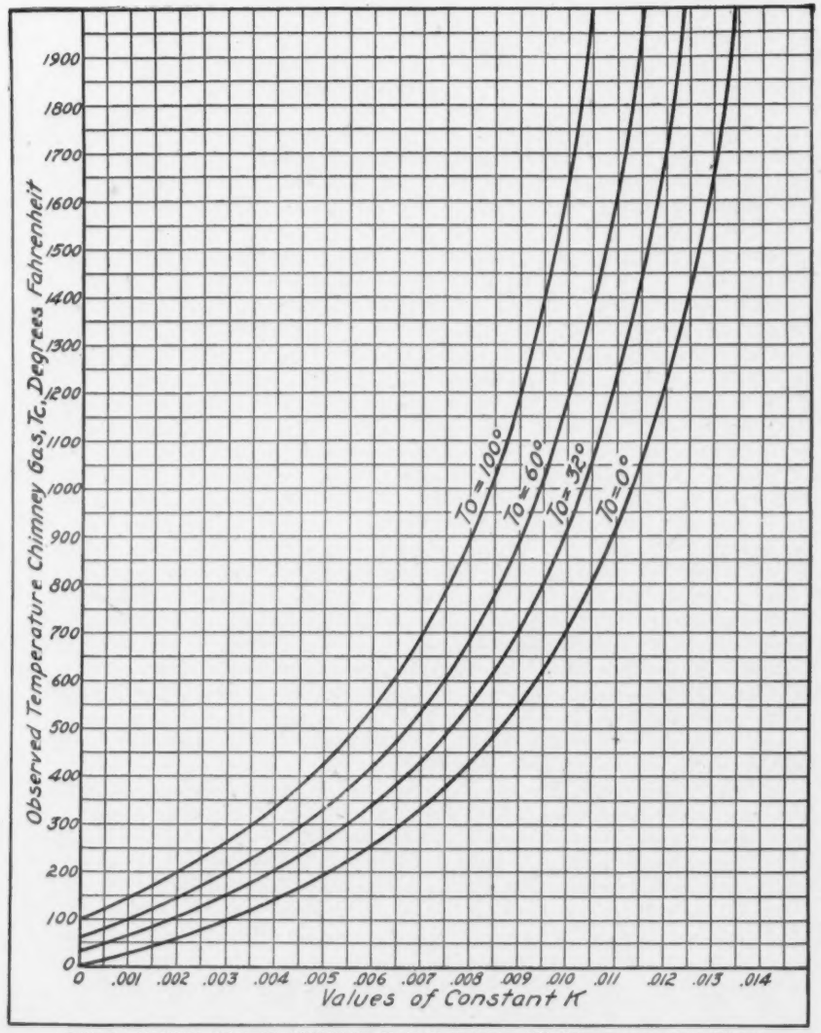


FIG. 1—VALUES OF THE CONSTANT K MAY BE DETERMINED FROM THIS CURVE

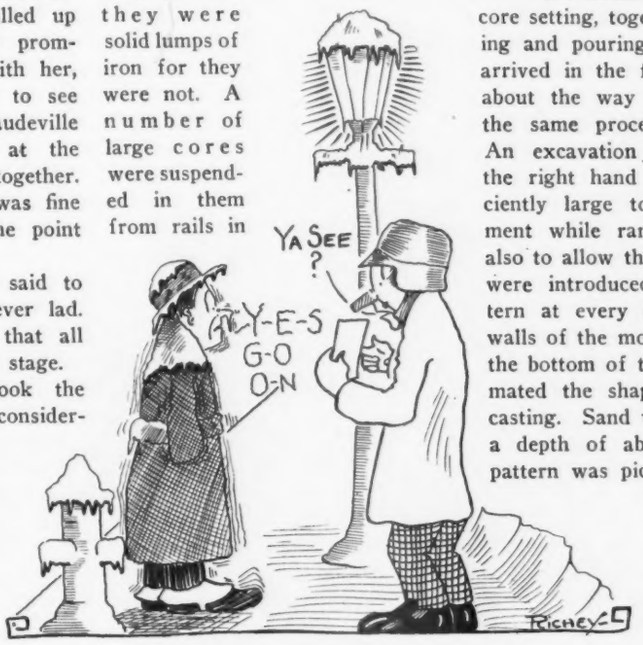
Bill Does Some Ladle Juggling

BY PAT DWYER

AMONG the items which caught my eye in a recent Sunday paper was a movie ad to the effect that a story which I had read under peculiarly happy circumstances many years ago had been filmed and during the next week it would be shown at a local theater. I approached the family treasurer diplomatically that evening and suggested that we throw dull care to the winds and go see the picture some night during the week. She said that she would see about it. A few nights afterward she announced that she had called up Mrs. Bill and that lady had promised to come and bring Bill with her, and we all would go together to see that film and certain other vaudeville acts that followed. We met at the theater and saw the show together. When we came out the night was fine and we decided to walk to the point where our ways divided.

Commenting on the show, I said to Bill that the juggler was a clever lad. He agreed with me but said that all juggling was not done on the stage.

"You don't want to overlook the fact," said he, "that there is considerable juggling done in the foundry sometimes. Juggling four balls with two hands had nothing on juggling four ladles of iron with two cranes to pour one casting." I asked him where had he seen that done. "We had some foundation castings to make for two hot metal mixers one time," said he. "For convenience in handling the job both in the foundry and at its destination each casting was made in three sections, front, back and center. Two patterns were made, one for the center and the other by reversing some of the parts served to make right and left hand end castings. The center sections weighed 85,000 pounds each, and the front and back pieces weighed 82,000 pounds each. Each section was approximately 22 x 6 x 4 feet, which made them quite respectable lumps to handle in a foundry equipped with one 20-ton and one 25-ton crane. We had two cupolas, one 48 inches and the other 60 inches in diameter inside the lining. The molding features presented no special difficulties, but the problem of pouring the castings required some consideration. They were destined to rest on concrete foundations and we were allowed to cast them in open sand. Do not infer from the molding method employed that they were solid lumps of iron for they were not. A number of large cores were suspended in them from rails in such a way as to produce an average metal thickness of 4 inches all over the casting.



BILL DOES A CHALK TALK BY ARC LIGHT

"The foundry floor under the crane was 40 feet wide so we decided to dig two pits at one end of the shop and use them alternately until the entire order of 12 castings was made. I'll make you a rough sketch of the general layout of the job and you will see what I mean."

He pulled an envelope and a little stubby pencil out of his pocket and stopped under a street lamp to make an outline drawing. I have corrected and straightened out some of the wavy freehand lines but otherwise the sketch was like the illustration.

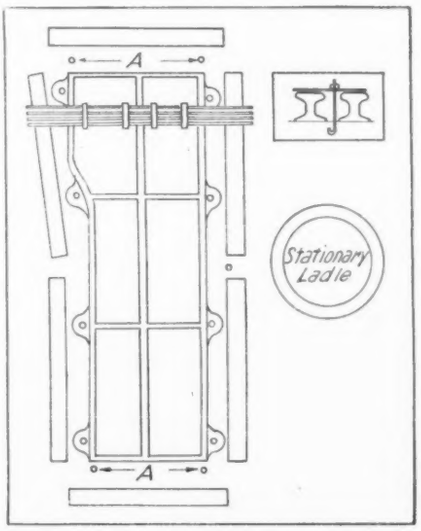
"There," said he, "it is neither fine nor fancy and no attempt made to show detail, but the general features of the job are there and that is all you need. I was comparatively young at the game in those days but had the pleasure of being associated with a competent young man and together we worked out all the details of the molding, coremaking, core setting, together with the method of melting and pouring the iron, before the patterns arrived in the foundry. I shall just tell you about the way we handled one of them as the same procedure was observed with all. An excavation first was made for one of the right hand sections. It was made sufficiently large to allow the men free movement while ramming up the side walls and also to allow the use of fairly long rods which were introduced at right angles to the pattern at every course of sand to stiffen the walls of the mold. A coke bed was spread on the bottom of the hole which roughly approximated the shape of the bottom face of the casting. Sand was shoveled in and rammed to a depth of about 6 inches after which the pattern was picked up by the crane and lowered into the pit. It was blocked up on short pieces of rails in several places and then by the insertion of wedges at the necessary points it was adjusted until the top face was level. If the bottom face of the pattern had been straight we would have put down permanent bearings to serve for the entire run of castings; but the bottom face was uneven in contour, so we had to adjust the pattern to a level each time it was used. Facing sand was tucked under the pattern and rammed firmly. When a sufficient quantity of sand had been rammed under the pattern to sustain its weight, the wedges were withdrawn and the cavities filled with facing sand. The short pieces of rails were not dis-

turbed, but were left in their places.

"Two large upright gate sticks were located at each end and one at the center of one side, *A* in the illustration. Ramming then proceeded in 6-inch courses, a row of stiff rods about 2 feet long being laid at each course. When the sand was rammed to within a foot of the top of the pattern, it was scraped around uniformly and long iron weights bedded all around the pattern. Those at the sides about a foot back from the pattern and those at the ends quite close to the back of the gate sticks. The weights were adjusted until their upper faces came on a plane with the top face of the pattern. Sand was then rammed between the weights and the pattern until the top was reached when the surplus sand was scraped off flush with the pattern. A row of vent holes was pushed down all around the pattern with a ½-inch vent wire and then a crane was hooked on and the pattern was drawn out of the sand. The bottom was thoroughly vented by the same method, after which the mold was finished in the usual way and given a thick coat of silica wash. A good grade of plumbago would have answered the purpose but the silica wash was cheaper. Furthermore, we made steel castings in the same foundry and the silica wash was the most available. In fact we used it on all our molds for heavy gray iron castings.

"We made three classy coke baskets for drying these molds. An open sand bed was made 3 feet 6 inches by 7 feet. Two 3-foot rings were scribed on the face of the bed side by side. A gutter was cut on the line of each ring with a gate cutter. A row of ¾-inch rods about 2½ feet long and about 3 inches apart was stood up in one of these rings. The ring was then poured and when it had cooled was inverted and the loose ends of the rods set in the other ring which was then poured. Three salamanders were made in this manner. A row of short pieces of scrap pipe was laid across the bottom to act as grate bars and a coke fire built in each. The fires were started in the yard to keep the smoke out of the shop. When the fires were going nicely they were brought back into the foundry. A long pipe was attached to each salamander by a pair of hooks and the fire lowered into the mold. The long bars supporting the baskets rested on the weights on each side of the mold and kept them at the right distance from the bottom face of the mold. Long sheets of corrugated iron were used to cover the mold and keep the heat inside.

"We arranged to pour one of these castings every Monday. This was for two reasons. In handling so many large cores which had to be attached



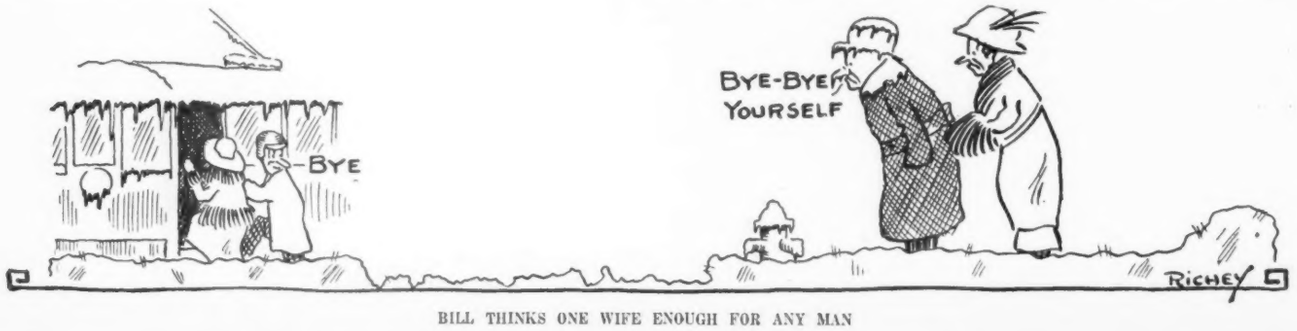
BILL'S LAYOUT FOR POURING, SHOWING THE ARRANGEMENT FOR SUPPORTING THE CORES

to and suspended from rails in the manner shown in the illustration one crane was practically tied up all day on this one job. We overcame this difficulty and prevented crane congestion by coring one of the molds every Sunday. The other difficulty which made Monday pouring necessary, was that the heat was so much in excess of our usual daily melt that we had to work the furnace gang on Sunday getting up the extra charge.

"We had one 15-ton, one 10-ton and one 5-ton ladle. Obviously it was necessary to find some way of augmenting our pouring capacity. We held council with our friend the superintendent of the blast furnaces which were connected with our establishment, and he kindly loaned us a spare 20-ton hot metal ladle. Two holes were cut on opposite sides flush with the brick bottom of this ladle. The ladle then was set permanently on the floor between the two pits in which the castings were molded and either side could be tapped, depending on which mold was ready. To handle the 45 tons of iron as a unit, we put 15 tons in the stationary ladle, filled the 15-ton and the 10-ton, poured them all together, then dropped the 10-ton and picked up the 5-ton, which was filled by that time. The contents of the latter was not all required but we used as much of it as was found necessary.

"The next proposition we had to figure was the melting speed of each furnace and the best method of taking the iron away to have all the ladles ready at the same time. The 48-inch cupola could melt about 7 tons an hour and the 60-inch was good for 15 tons. We put the blast on the large cupola about half an hour ahead of the small one and placed the 15-ton ladle under the spout of the small cupola and the 10-ton ladle under the spout of the large one. The 10-ton ladle was filled first and dumped into the stationary ladle. This ladle was again partly filled and 5 tons poured into the same ladle. It was then placed back under the spout and filled after which it was taken out and placed in the hole provided at the end of the pouring basin. The crane was unhooked and attached to the 5-ton ladle which was then placed under the spout of the 60-inch cupola. By this time the 15-ton ladle was full so one crane picked it up and carried it to the far end of the mold. The other crane picked up the 10-ton ladle and when both ladles were properly set the stationary ladle was tapped and the three streams of iron entered the mold simultaneously. The 10-ton ladle was emptied first, set down out of the way and the 5-ton ladle which was full by this time was picked up and rushed over and enough of its contents poured in to bring the casting up flush.

"We left each casting in the sand until the Wednesday after it was



BILL THINKS ONE WIFE ENOUGH FOR ANY MAN

poured, before lifting it out. This left the hole cool to start in on the following Monday. Two molders and two helpers made a complete mold every week. Two coremakers made the set of cores in the same time and on Sunday the coremakers and molders together assembled the cores and placed them in the mold. It took us three months to finish the job. I don't mind admitting that I was quite interested in it and not a little proud of the satisfactory way in which everything was going. You can imagine the jolt I got one night when my One-and-Only said that if I intended sticking down in that old foundry seven days every week I had better look for another wife."

"Well," I said, "what did you do?"

"Do," said he, as he stepped off the curb to catch a car, linking his wife's arm at the same time, "No man can serve two masters and I still have the same wife I started out with."

Gas Forms Efficient Core Oven Fuel

BY W. A. EHLERS

IT IS generally admitted that the subject of core drying in the foundry does not receive the attention it deserves. The methods usually followed in this work are those advocated years ago, and are by no means the most efficient means of obtaining uniform results. Aside from the crude method of heating, many coremakers have vague ideas about the necessary temperatures in the core oven or how long a core should be baked. Heavy losses in time, materials and the slowing down of production may be traced to inferior methods of core drying. Underbaked cores or molds develop steam when brought into contact with the molten iron. The steam must have free passage to escape, or blow holes will be formed in the casting. Overbaking, caused by excessive temperature and localized heating produces cores which are weak and therefore unfit for use. There are almost as many types of core and mold drying ovens as there are opinions on the kind of fuels to be used and the manner of applying and utilizing the heat from these fuels. It is just as important, or even more so, that a core oven should be properly heated as an oven in which bread or pastry is baked. The wastage from improperly baked cores amounts to more in actual value than when bread and pastry are improperly baked. The success which has been met in the design of an oven which will bake bread uniformly is an indication of what might profitably be done in core and mold ovens. There is perhaps no item of greater importance than that of determining the proper temperature at which the cores should be baked, and the length of time they should be subjected to that temperature. In most cases, particularly in large ovens, the temperature varies from 800 to 900 degrees Fahr. in portions of the oven nearest the fire to 200 to 300 degrees in other places. It is customary to build an exceedingly hot fire, allow it to run for an hour or two, then allow it to die out. Uniform temperature in the oven under this method is impossible.

A TYPICAL CARLOAD OF CORES IN A GAS FIRED OVEN—NOTE THE LIGHT CORES ON TOP AND THE COMPARATIVELY HEAVY CORES ON THE BOTTOM

Gas for core drying or other heating operations can be easily applied, the burners uniformly distributed, and automatically controlled. Among the numerous advantages of gas (either natural or city gas) may be mentioned:

Time of heat is shortened, therefore increased capacity is secured with a given equipment. No burned cores or molds result. The ovens may be fully charged. Binding agents in cores and molds are not burned out. Maintenance charges are reduced.

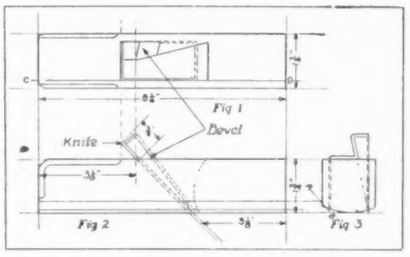
In order to substantiate some of the above claims for gas fuel the following results taken from some recent installations may be of interest. A test extending over one week was made on an oven, 10 x 16 x 24 feet, heated with city gas. The truck and shelving alone weighed 25,000 pounds. Meter readings and temperatures were taken every hour, and the cores were weighed every day. Seventy-five tons of baked cores were produced during the week at an average cost of $0.48 per ton for fuel and power. Likewise a careful test was made using coke for fuel at $7.50 per ton in stock at the plant. Allowing for all items chargeable to the coke-fired ovens, the cost to produce a ton of cores amounted to $0.76. Another plant gives results similar to those mentioned. In this plant cores weighing from ¼ to 50 pounds were placed, some on trucks and some on shelves, the total being 4000 pounds. Gas was burned 2½ hours until a temperature of 345 degrees Fahr. was obtained. It was then turned off and the baking continued from the heat absorbed by the oven.

The results of these tests indicate that the cost of gas and power per ton of cores was $0.94 as against $1.09 with coke and wood. In this vicinity the cost of gas per 1000 cubic feet was about 50 per cent higher than in the other installation; but even under these conditions a saving was shown by the use of gas fuel. It was also found that all cores were properly baked regardless of weather conditions. Those on the floor of the oven were baked as well as those on top. In one case 6000-pound and ¼-pound cores were baked at one time.

Practical Tips For the Foundryman

Patternmakers' Round Bottom Planes—Wide Gears From Narrow Patterns—Altering a Pattern for Economic Reasons—Steel Spokes in Roller Wheels —Air Hose Attachment to Clean Molds

PATTERNMAKERS do not take kindly to the round bottom planes found in tool supply stores. They feel that these tools are not suitable for patternmakers use and they take up considerable room in the tool kit. I have a set of these regular tool supply planes cut down and remodeled to the shape and dimensions shown, in the illustration. The radii of the bottoms are ½, 1, 1½, 2, 2½, 3, 4, 5, 7½ and 10 inches. The open side of each plane is closed with a piece of maple securely glued, and shaped and finished like the opposite side. See *C D* Fig. 1. Starting at the wedge the side of the throat is made tapering toward the front Fig. 1 and from the top of the plane down as in Fig. 3. The wedge or key is made unlike any I have ever seen. The front face is made with a bevel that fits into a corresponding bevel in the plane. The bevel forces the wedge against the side of the plane and keeps it always in the same relative



DESIGN OF A ROUND BOTTOM PLANE

position leaving no space for shavings to get in and clog up the throat of the plane.

The work of finishing the throat of the plane should be done while the knife and wedge are in place. The whole plane should then be given three coats of clear shellac varnish each coat being allowed 24 hours in which to dry hard. If afterward the throat of the plane is given an oil finish the tool will be a pleasure to use in the patternshop.

Just a word about setting a round bottom plane in order. Set the knife in the center of the throat, let the edge protrude beyond the bottom just enough to expose the edge the full width of the blade. Pass the plane over the oil stone in the same manner as when dressing a board. Take the knife out of the plane and grind it in the regular manner but be careful not to destroy the curvature of the edge which has just been shaped to the curvature of the plane. Some skill and practice is needed to do this satisfactorily.

By M. E. Duggan

Wide Gears From Narrow Patterns

BY WILLIS J. DAWSON

OFTEN in a foundry a molder is called upon to make a gear from a pattern which is the desired diameter, and has the right number and pitch of teeth but the face is not wide enough. The common method is to lay blocks of wood on the roll-over board and set the pattern on them. The thickness of these blocks is the difference between the width of the pattern and the required casting. The drag is rammed and rolled over and then sand is dug out to the top of the pattern. Then comes the tedious job of drawing the pattern a little at a time, tucking the sand carefully in the teeth until the top of the pattern is up level with the face of the drag. The molder then draws the pattern, having first marked both pattern and mold so that he may be able to return the pattern to its original position. Next the blocks which were used before are set on the bottom face of the mold and the pattern is carefully lowered until it rests on them. These blocks hold the pattern in place while the cope is being rammed. If the pattern has been drawn carefully each time a satisfactory casting may result; but I have seen molds made in this manner that seemed all right until the pattern was drawn for the last time. Then small areas would be found crushed off the sand teeth by tucking too hard at some stage of the operation. I also have seen the casting with swells on different parts of the teeth where the sand was not tucked hard enough. This method is an unsatisfactory way of molding a wide gear especially those having fine teeth.

The writer was called upon recently to make a brass pinion 6 inches in diameter, with a 2-inch face and 48 teeth. The cast-iron pattern supplied was the right diameter and had the required number of teeth but only had a ¾-inch face. The teeth were too fine for drawing up in green sand to the required width and some other method had to be adopted. The pattern was plain with a ¼-inch depression on each side of the web.

I first procured a square frame 2 inches wider on the inside than the diameter of the gear pattern and 1 inch deeper. The frame was laid on a smooth board and the pattern centered in it, as if it was a drag. An oil mixture of core sand with a little flour to add toughness was used to fill the frame. When it was rammed, struck off, rolled over on a core plate and the pattern drawn I had a mold for the bottom part of the gear and ¾-inch of the face.

Next a frame the same size as before but the exact depth of the pattern was rammed in the same manner and the pattern drawn again. When the cores were dried a bed was leveled in the bottom of a drag at a height which would bring the assembled cores and pattern ¼-inch above the joint.

The drag core forming the bottom of the gear and ¾-inch of face was set in first, then on top of this the ring core forming an additional ¾-inch, the sand teeth being carefully lined with each other. The two sections of core combined made up 1½ inches leaving ½-inch of the required face still to be made up. The pattern was only three-quarters of an inch thick so I laid three 1¼-inch blocks into the bottom core and lowered the pattern down until it rested on the blocks. This left the pattern standing ½-inch above the cores. This space was filled with green sand and a row of nails laid, one in each tooth, to make it firm. The cope was rammed and finished in the usual manner. This method produced a casting which was satisfactory for the purpose intended.

Altering a Pattern for Economic Reasons

By Ernest Schwartz

When there are several alternative ways of making a pattern, the deciding factor which influences the patternmaker in his choice is the probable number of castings to be made from it. If only one casting is to be made the pattern is put together with a minimum of expense in the pattern shop. However, if more than one casting is required the problem is to reduce the molding time in the foundry.

A case of that kind occurred in making the pattern for the crown end bearing for a 10-horsepower motor and shown in the accompanying illustrations. The original order only called for one casting and it was not anticipated that more than two or three would be required altogether. For that reason the pattern was made with a minimum of expense in the following manner: A core print was built up to the form of the inside of the casting with the flange *B* attached to it as shown in Fig. 2. The four ribs or arms joining the flange *B* to the boss *C* were made separately and then attached to this large dry-sand core was eliminated entirely and the job was made in green sand. To accomplish this purpose a pattern was made as shown in Fig. 4 and parted at *E-E*. It will be seen that if a wood pattern was used the shoulders *C-C* would be dangerously weak. They were strengthened by fitting knee pieces inside as at *D-D*. After the pattern was drawn small cores having one face conforming to the shape of the arm were dropped in the depressions left by the knee pieces. If the size of the order warranted making a metal pattern the knee pieces would have been unnecessary.

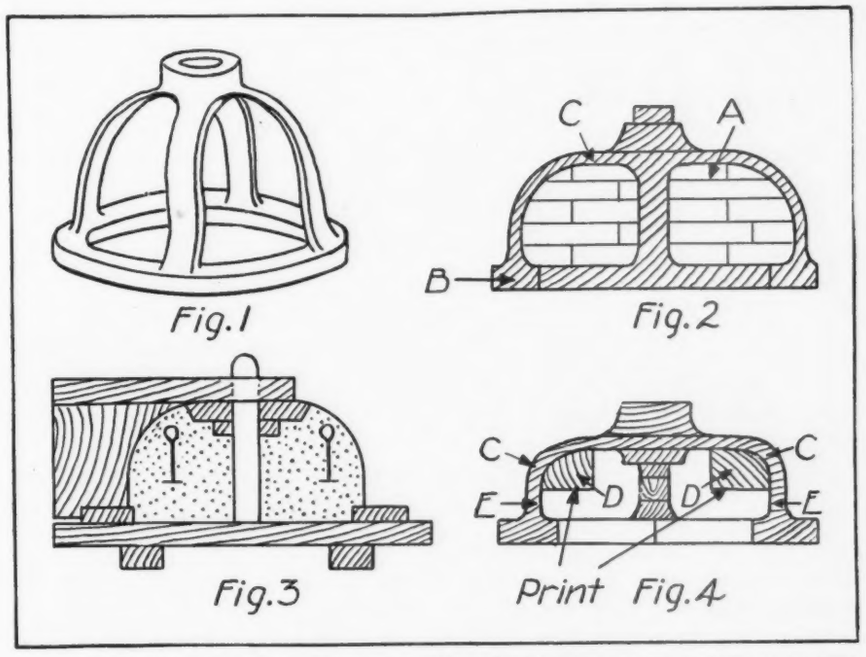


FIG. 1—END BEARING FOR A MOTOR FIG. 2—CORE PRINT MADE FIRST—THE FOUR ARMS WERE ATTACHED TO THIS FIG. 3—SWEEPING UP THE CORE FIG. 4—PATTERN FOR A LARGE NUMBER OF CASTINGS

large round print. The core for taking out the inside was made on the pin board shown in Fig. 3. It contained a print on the top for locating a piece of standard stock core designed to form the shaft bearing.

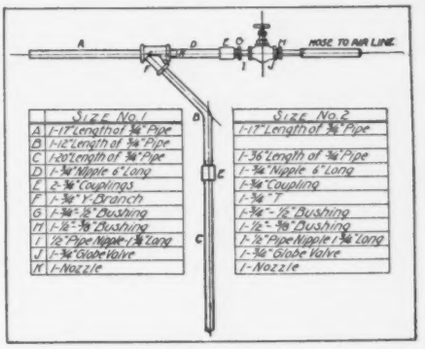
Later a number of these castings were ordered and it was considered advisable to make a pattern of new design in order to reduce molding costs. The

Steel Spokes Work Loose in Roller Wheels

By Pat Dwyer

Question: We are casting roller wheels which weigh in the neighborhood of 4500 pounds and are using ⅝ x 2½-inch soft steel spokes. The rim is cast one day and the hub the next. The wheel when it leaves the foundry appears satisfactory but when it has been machined and placed on the roller, we find that the spokes show a tendency to loosen and draw away from both rim and hub. We have had some discussion as to the proper method of casting these wheels. There appears to be a difference of opinion as to whether the rim or the hub should be cast first.

Answer: In all cases of this kind where the rim and the hub are separate castings the rim is poured first and allowed to cool before pouring the hub. The reason for this of course being that the rim on account of its greater circumference shrinks a great deal more than the hub. The reason the spokes work loose in some cases is because the molten iron has not fused to them properly. This may be due to two reasons, there may be something on the end of the spokes which repels the molten iron, or the iron may be poured at too low a temperature to fuse to the ends.


HOSE TO AIR LINE
SIZE No. 1
A 1-17" Length of ¾" Pipe
B 1-12" Length of ¾" Pipe
C 1-20" Length of ¾" Pipe
D 1-¾" Nipple 6" Long
E 2-¾" Couplings
F 1-¾" x ¾" Branch
G 1-¾" - ½" Bushing
H 1-½" - ¾" Bushing
I 1-½" Pipe Nipple 1¾" Long
J 1-¾" Globe Valve
K 1-Nozzle
SIZE No. 2
1-17" Length of ¾" Pipe
1-36" Length of ¾" Pipe
1-¾" Nipple 6" Long
1-¾" Coupling
1-¾" T
1-¾" - ½" Bushing
1-½" - ¾" Bushing
1-½" Pipe Nipple 1¾" Long
1-¾" Globe Valve
1-Nozzle

STANDARD PIPING CAN BE FITTED UP FOR CLEANING MOLDS

To prepare the ends of the spokes, they should be split or fork-tailed, then nicked with a chisel on the part which is to be imbedded in the cast iron. The ends should be cleaned thoroughly to remove any rust or scale and either dipped in molten tin or painted with a solution of silicate of sodium, generally referred to as "water glass." Use hot iron to pour the rim and hub. It is generally necessary to run about 50 pounds of iron through the hub and afterward feed up with a rod.

Air Hose Attachment for Cleaning Molds

By George W. Childs

An assembled arrangement of standard piping and fittings for attachment to the air line for cleaning foundry molds is shown in the accompanying illustration. The apparatus when completed is attached to the end of the air hose at *X*. When in use the end of the ¾-inch pipe *C* is let down into the mold, the globe valve *J* is opened and the refuse sucked up and blown out through the pipe *A*. It also may be used for blowing the refuse out direct by holding one hand over the end of the pipe *C*, and opening the globe valve when the refuse will be blown out through the pipe *A*. Two sizes of apparatus are listed in the table, the pipes *A* and *C* being of different lengths. They have been found quite satisfactory for the purposes intended. This simple arrangement can be fitted up by any pipefitter and affords an efficient method of removing the loose sand.

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG.....Prince's Chambers
BOSTON.....426 Old South Bldg.
CHICAGO.....1147 Peoples Gas Bldg.
CINCINNATI.....501-505 Commercial Tribune Bldg.
LONDON, ENG.....16 Regent St., Dorland House
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
WASHINGTON, D. C.....40 Metzerott Bldg.

SUBSCRIPTION

United States and Mexico.....$2.00 a year
Canada.....$3.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....15 cents

Copies published three months or more previous to date of current issue, 25 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulation and Associated Business Papers Incorporated

ENTERED AT THE POST OFFICE AT CLEVELAND AS SECOND CLASS MATTER

Copyright 1920 by the Penton Publishing Co.

Contents

	Page
Permanent Employment is Assured	1
Keeping Dirt Particles Out of Castings	5
Adapting a Skip Hoist to the Cupola	6
Patching Doubles Life of Furnace Roof	10
Buys Aircraft Plant	10
Training Men in the Molding Art	11
Conditioning Molding Sand	13
Why Molds are Swabbed	13
Tips on Drawing Patterns	14
Using Charcoal on Metal	14
Pittsburgh Foundrymen Hold Annual Dinner	14
Efficient Rig for Making Cylinders	15
Foundryman Writes of Cupola Practice	16
Casts Large Tonnage of Aluminum	17
How and Why in Brass Founding	24
Mixing Brass, Antimony and Lead	24
Making Nickel Babbitt	24
Lime Resisting Bearings	24
Facings for Aluminum	24
Molten Covering for Brass in the Furnace	24
Casting Zinc Ingots	24
Spiegeleisen used in Steelmaking	25
Form Foundry Association in Connecticut	25
Castings for Ship Construction—XVII	26
French Foundries in Occupied Areas Resume	28
Standardizing Foundry Operations	29
Bill Does Some Ladle Juggling	31
Gas Forms Efficient Core Oven Fuel	33
Practical Tips For the Foundryman	34
Wide Gears from Narrow Patterns	34
Altering a Pattern for Economic Reasons	35
Steel Spokes Work Loose in Roller Wheels	35
Air Hose Attachment for Cleaning Molds	35
Chemistry and the Foundry	36
Trade Outlook in the Foundry Industry	37
Comings and Goings of Foundrymen	38
Addresses New England Foundrymen	38
New Aluminum Solder	38
Designs New Type Jarring Machine	39
Rotating Melting Furnace	39
Gage Records the Blast Pressure	40
Produces Compound for Duplicate Patterns	40
Nozzel Grinding Device	41
American Radiator Buys Plant Site	41
Obituary	41
What the Foundries Are Doing	41
New Trade Publications	42

Chemistry and the Foundry

ACCORDING to contemporary records bronze was the first metal to be cast and iron was next in order. The history of brass extends back as far as we have any established record of human activities, and there are authenticated instances of iron castings having been made several centuries ago. Cast steel, the third and also the youngest member of this group of widely used metals, was first made within the memory of men still living. Despite this fact, the manufacture of steel castings has reached a higher state of development than the production of castings from either of the other metals. There are many places where iron and brass castings are made in a highly creditable and efficient manner; but in proportion to the number of shops engaged in the casting industry, the steel foundries have by far the most scientific metallurgical control. The reason is not far to seek. It all lies in the one word, chemistry. Tradition and guesswork, the result of centuries of custom, still obtain to a greater or less extent in the iron and nonferrous field. Steel foundry practice has been based, from the first, directly on chemical analysis. Those who order steel castings distinctly specify certain chemical analyses or physical requirements for the steel in castings destined for different lines of work, and the steel foundrymen have to meet these specifications. Making the molds, while important to a certain extent, is secondary to the preparation of the metal. It is necessary not only to melt the raw material, but the charge must be manipulated and treated until a composition of metal is secured within certain limits for the different elements. The very rigidity of the specifications which the steel foundryman has to meet forces him to exercise the highest degree of skill and knowledge and has been the means of placing the steel casting industry on the proud pinnacle upon which it stands at the present time. There is no good reason why the iron casting industry should not be conducted on the same high metallurgical plane. As pointed out previously, there are instances where gray-iron foundries are scientifically controlled, but such cases are mostly confined to shops specializing in one line of work. In these places the composition of the iron is watched and controlled by chemical analyses as closely as it is in any steel plant. However, a great majority of iron foundrymen still make up their mixtures by a general rule of averages and trust to luck to get good castings. If these men only could be brought to realize that scientific melting and mixing not only would be the means of raising the casting industry to a higher plane, but also would serve as an economic factor in reducing their costs, the general adoption of such methods would be assured. The cupola not only is the cheapest melting medium, but it is also the most flexible. The arrangement of the charge in alternate layers of coke and iron lends itself readily to the production of as many different grades of iron during one heat as may be necessary to meet the requirements of any gray-iron foundry. Furthermore, knowledge of the proper composition of iron for the different classes of castings being produced will provide a basis for buying just the right kind of pig iron and eliminate the use of high-priced iron in castings which do not require it and vice versa. It is a subject well worth the attention and consideration of men engaged in the production of iron castings, for the best economic reasons.

Trade Outlook in the Foundry Industry

WITH the spectre of fuel famine allayed and a continued enduring faith in the present prosperity and future prospects of ample orders, the foundry industry enters upon 1920 as a year of unprecedented activity. Prices of raw materials continued to advance through the closing months of 1919 and sharply at its close under the combined impetus of strikes and threatened shortage of both fuel and metals. However, buyers of castings have these factors in mind and with the strong probability of still further advances confronting them have hastened to place their orders upon the foundrymen's books, gladly paying higher prices and anxious only for deliveries.

Coke Still Lags

Tightness still exists in the coke situation. With the return of full time operations in the mines, has come a burden upon transportation facilities which, to use the oft-repeated analogy, has brought a marked restriction at the neck of the bottle. Oven operators are falling behind on their contract obligations as the car supply at some points is only 10 per cent and nowhere through the eastern coke regions does it exceed 30 per cent, so that full operation of the ovens is impossible. Blast furnaces, unable to supply their own needs in many instances due to the continued shortage of coal for by-product oven operation, are clamoring for coke from outside sources and contending with other regular customers for the scanty output available. Government price restrictions remain in force relative to coke prices, but it is reported that some interests are paying higher than the schedule in the endeavor to secure supplies. The price restriction probably will not be removed until the coal prices finally are adjusted sometime within the next 60 days. Sales for first half delivery are being made at an advanced price, but generally with the provision that government prices which obtain at the time of delivery, will be honored. Coal production started momentously after the close of the strike with 48.1 per cent of normal output on the week of Dec. 13. If the car situation improves production soon will reach normal.

Prices of Raw Materials for Foundry Use

CORRECTED TO DEC. 24

Iron		Scrap	
No. 2 Foundry, Valley	$38.00	Heavy melting steel, Valley	$23.00 to 23.50
No. 2 Southern, Birmingham	35.00 to 40.00	Heavy melting steel, Pittsburgh	25.00
No. 2 Foundry, Chicago	40.00	Heavy melting steel, Chicago	22.50 to 22.75
No. 2 Foundry, Philadelphia	40.10 to 41.10	Stove plate, Chicago	29.50 to 30.00
Basic, Valley	35.00	No. 1 cast, Chicago	36.50 to 37.00
Malleable, Chicago	40.50	No. 1 cast, Philadelphia	31.00 to 33.00
Malleable, Buffalo	39.25 to 40.25	No. 1 cast, Birmingham	26.00 to 27.00
Coke		Car wheels, iron, Pittsburgh	31.00 to 32.00
Connellsville foundry coke	$7.00	Car wheels, iron, Chicago	31.50 to 32.00
Wise county foundry coke	8.25	Railroad malleable, Chicago	29.00 to 30.00
		Agricultural malleable, Chicago	29.50 to 30.00

Iron Grows Scarce

Speculation as to the probable effect of the limited coke production coupled with the unprecedented demand for foundry grades has produced a market for pig iron which is strongly bullish. Sellers state that the country is about to experience a shortage of pig iron which will approach that which prevailed at times during the war. Northern furnaces in general are sold through the first half and some have taken orders for delivery at dates as remote as next November. Spot iron is scarce and off grades are snatched eagerly. Southern producers, in the main, have remained aloof on future orders, and some state that they are retaining first half production exclusively for old customers. A novel situation exists in the vicinity of Chicago, where all available gondola-type railway cars are busy hauling Illinois and Indiana coal. In this region open-top cars cannot be had for shipping foundry iron, and box cars or stock cars are being used where sufficient labor can be obtained to load them.

Business is Brisk

In practically all lines, foundries continue to be increasingly busy. Automobile production for 1920 will require greater foundry capacity than ever before. Passenger cars and trucks as well as the increasing varieties of tractors for agricultural and industrial uses will be built in unprecedented numbers. During 1917 under augmented war requirements $220,000,000 worth of trucks were produced. In 1918 this figure was increased to $434,000,000 and 1919 probably will have exceeded even this total. Agricultural implements are more active this winter than at any previous time since the armistice. Building construction in almost all localities throughout the country has been greater for 1919 than for any year since 1910. Statistics compiled by the F. W. Dodge Co., New York, show that in the territory north of the Ohio river and east of the Missouri, contracts totaling $2,332,902,000 were awarded in the first 11 months, exceeding by $700,973,000 or 43 per cent the record of the same period of the previous year. In the New England states also, the total of 1919 was about 45 per cent greater. In practically all districts this remarkable increase in building operations carries with it a demand upon foundries for castings used directly in heating and sanitary appurtenances and indirectly in the many municipal extensions of waterworks and sewerage facilities. Cast iron pipe, reflecting the rising material and labor prices and increasing demand has been advanced by about $4 per ton. Although railway buying on a large scale is still remote, repairs are greatly in demand, and a corresponding increase in inquiry for railway castings is noted. The American Steel Foundries Co., although operating but five of its nine plants has all the business that it can handle in the active establishments. Many foreign inquiries for railway materials are reported. Malleable shops throughout the country are operating at about 85 per cent of capacity.

Nonferrous metals based on New York prices are quoted as follows: Copper, 18.50c; lead, 7.30c to 7.35c; tin, 56.00c to 56.25c; antimony, 9.75c to 9.87½c; aluminum, No. 12 alloy, producers' price, 31.50c and open market, 30.50c. Zinc is quoted at 8.50c, St. Louis.

Comings and Goings of Foundrymen

JOHN H. DWIGHT, for seven years vice president and general manager of the Belle City Malleable Iron Co. and the Racine Steel Casting Co., Racine, Wis., has tendered his resignation, to take effect Jan. 1, and will join the Saginaw Products Co., Saginaw, Mich., as vice president in charge of production. The Saginaw company is a division of the General Motors Corp. Mr. Dwight went to Racine from Chicago in 1904 and with the exception of five years was associated with the malleable and steel companies. For a time he was secretary of the Racine Rubber Co. and afterward manager of the wagon department of the Mitchell Motors Co., rejoining the Belle City company in 1912.

Harry Connors is superintendent of Co. which recently started operations in new foundry.

William H. Hahn has been made foundry superintendent of the new shop of the Freed Furnace Co., Oaks, Pa.

Martin Stuit has been made treasurer of the Standard Malleable Iron Works, Muskegon, Mich.

R. A. Young, formerly assistant chief draftsman for the W. W. Sly Mfg. Co., Cleveland, has opened an office as consulting foundry engineer in the Erie building, Cleveland.

Samuel Stoneham has resigned as general superintendent of the Union Steel Casting Co., Boston, and the duties of his office at present are being discharged by A. F. S. Blackwood, vice president.

C. E. Cullum has accepted a position as production superintendent for the Industrial Foundry Co., St. Johns, Mich. Mr. Cullum formerly was supervisor of foundry practice for the General Motors Co.

Wilford F. Stork has become foundry superintendent of the Detroit Valve & Fitting Co., Wyandotte, Mich., having formerly been metallurgist of the Michigan Motor Casting Co., Buick division, Flint, Mich.

W. R. Phibbs has resigned as assistant general manager at the Maysville, Wis., plant of the Steel & Tube Co. of America, to become eastern representative of the James A. Brady Foundry Co., manufacturer of forced draft stokers.

Samuel A. Craig, formerly district manager with headquarters in Philadelphia of the Norton Co., Worcester, Mass., will sail for Japan early in January, where he will be located permanently in the interest of the company.

F. B. Williams has become assistant superintendent of the Watertown, Mass., plant of the Walker & Pratt Mfg. Co., house heating boilers. Mr. Williams was previously captain in the ordnance department during the war.

H. E. Beck, who has been with the Dennison Foundry & Machine Co., Dennison, O., for the past 15 years, has resigned his position as manager, effective Jan. 1. Mr. Beck now is forming a company at Uhrichsville, O., to construct a new and modern foundry.

J. Ramsey Speer has resigned as president to become chairman of the board of the Pittsburgh Iron & Steel Foundries Co., Pittsburgh, and Charles McKnight, treasurer of the company, has been elected to succeed him as president. Mr. Speer served the company as vice president from 1899 to 1911, and as president from 1911 to Nov. 1 of this year. Mr. McKnight has been treasurer and a director of the company since 1899.

W. E. Fisher, of St. John, N. B., Canada, recently re-elected chairman of the maritime branch of the Canadian Manufacturers' association, is president of the Enterprise Foundry Co., Sackville, N. B., and vice president of the Enterprise Hardware Co., Sackville, and Emerson & Fisher, Ltd., St. John. He is a past president of the St. John Hardware association and the maritime board of trade and has filled other prominent positions in commercial organizations.

L. S. Kerchner, formerly general manager of the Dunbar furnaces of the American Manganese Mfg. Co., Philadelphia, has been placed in charge of the newly opened sales offices of that company in the Oliver building, Pittsburgh. Matthew J. Scammell, formerly assistant general manager of the Sparrow's Point plant of the Bethlehem Steel Co., succeeds Mr. Kerchner as general manager of the Dunbar furnaces.

Richard Muse, for more than 30 years with Marshall Foundry Co., which now is owned by the Valley Mold & Iron Corp., Sharpsville, Pa., and who for 24 years was general superintendent of its its foundry in Pittsburgh, has resigned.

R. H. Mills, who for the past two years has been Pacific coast representative for the Werner G. Smith Co., Cleveland, and more recently was in charge of their St. Louis sales office now is connected with Snow & Galgiana Co., San Francisco.

Addresses New England Foundry Meeting

At the regular meeting of the New England Foundrymen's association, held Wednesday, Dec. 10, Frank B. Gilbreth, consulting engineer of Providence, R. I., spoke on "What Industry Must Do to Allay Unrest and How It Must be Done." Mr. Gilbreth touched largely upon the efficiency of workers in performing their everyday operations. Some of the points he emphasized were: Greater conveniences for employes to cut down fatigue; instruction in proper method of handling work in order to reduce effort and to increase speed; and payment based on production. A nominating committee was appointed to make nominations for the officers for 1920 which will be voted on at the annual meeting in January. This committee consisted of three past presidents: B. M. Shaw, Walker-Pratt Mfg. Co., Boston; H. E. Wetherbee, James Hunter Machine Co., North Adams, Mass., and George P. Aborn, Worthington Pump Co., Boston.

New Aluminum Solder

Soldering aluminum has always been extremely difficult because of the close affinity between aluminum and oxygen. This affinity is so close in fact that immediately upon exposing a piece of pure aluminum to the air, a film of oxide is formed over the entire surface of the metal. This oxide cannot be removed permanently by scraping, for upon its removal another coat forms immediately. The Transmuted Metal Co., Chicago, has perfected a solder which it is claimed will resist these oxides.

The company states that any aluminum object from the thinnest foils up to the regular gages of sheet aluminum may be soldered with this material; the reason given being that it flows at 355 degrees Fahr., a temperature so low

that there is no danger of burning or distorting the metal. It is not affected by the oxygen in the air or by the oxides of aluminum which come to the surface when coming in contact with the air. The solder is nonelectrolytic and will not disintegrate or corrode. It will take a polish and when used on an aluminum article and then polished it is said to be impossible to find the part soldered.

The most simple test for electrolytic action is to place a small amount of solder on a piece of aluminum and submerge it in hot water. If the solder shows chemical action, through effervescent bubbles, it is electrolytic and is likely to disintegrate and corrode.

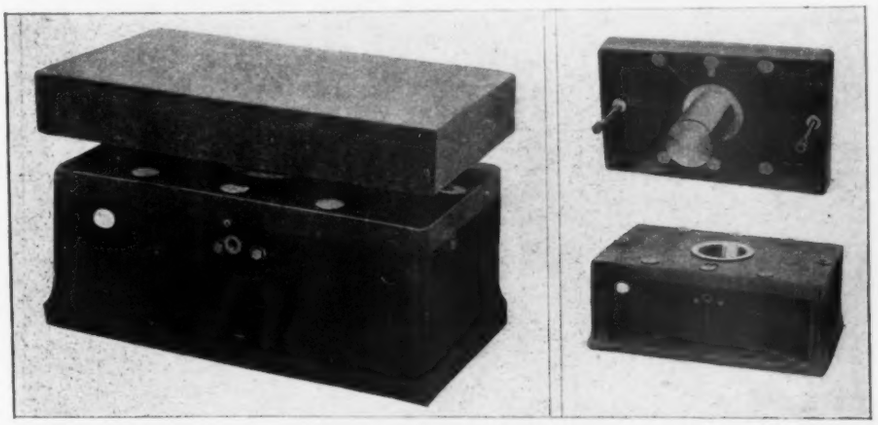
The principal rule for soldering sheet aluminum is to thoroughly tin the surfaces to be soldered. Dirt or spots must be removed from faces of the pieces to be united. The use of a fine brass wire brush is recommended as the quickest and most thorough way of tinning. Heat the surfaces until the solder flows and tin thoroughly with brush and apply the solder. After the object has been soldered do not cool or check in water, lay it aside to cool off naturally. Thin parts may be soldered with or without a soldering iron. If soldering iron is used it should be filed clean and tinned with half and half in the usual manner.

It is claimed that heavy parts, crankcases, manifolds, patterns or any kind of aluminum castings may be repaired with this solder. If a casting is cracked a *V* is filed in the crack and filled with solder. If the casting is broken, the method employed is to tin the broken surfaces, applying the solder and sweat the two parts together.

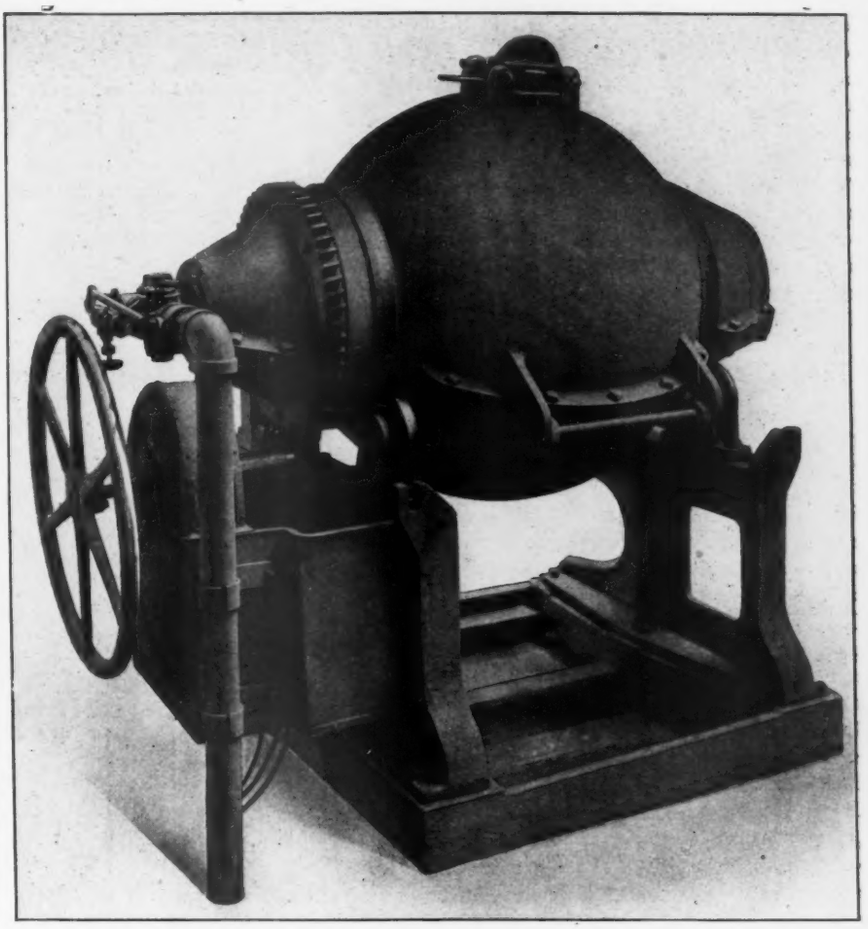
Designs New Type Jarring Machine

The new type of jarring molding machine lately developed by the E. J. Woodison Co., Detroit, as shown in the accompanying illustration, is built strongly and compactly for heavy duty. The contact points between the table and base are large and equally distributed. This feature is designed to eliminate the peening action, which in machines of this type, has a tendency eventually to warp and spring the table out of a straight line with resulting loss of efficiency.

It is claimed that on account of the solidity of the frame and the great amount of weight being properly placed in the base of this machine, the jar to the surrounding floor is reduced to a minimum. For the same reason the sand settles uniformly and the density of the packing may be regulated with great accuracy.



CONTACT POINTS BETWEEN THE TABLE AND BASE DISTRIBUTE THE IMPACT OF THE BLOW TO ALL PARTS OF THE MACHINE



ROTATING FURNACE GIVES GREATER LIFE TO LININGS

Rotating Melting Furnace

A continuous revolving noncrucible melting furnace, shown in the accompanying illustration, has been developed by the Monarch Engineering & Mfg. Co., its distinguishing feature being a motor-driven continuous rotary motion. It is claimed that this feature gives greater life to the lining, decreases the melting period and saves labor. It is made in five sizes ranging from a capacity of 250 pounds to 2000 pounds a heat. Gas or oil may be used for fuel with equal advantage. The cost of the fuel being the determining factor.

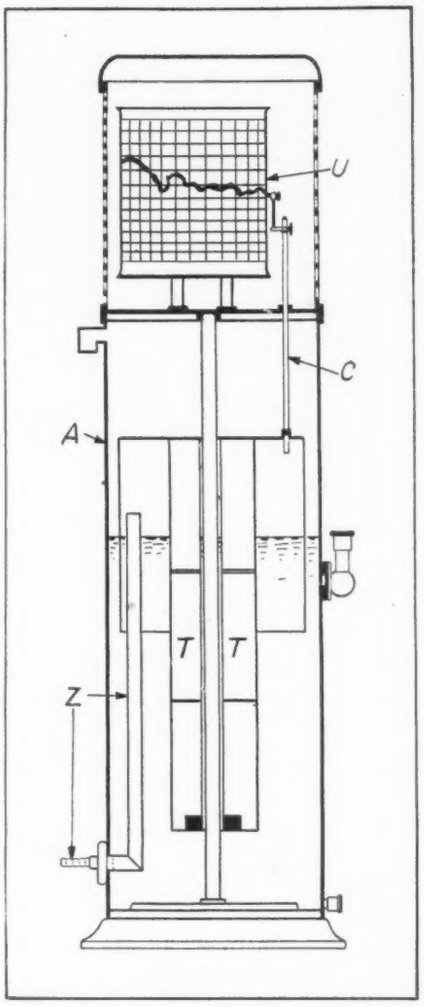
Besides being an economical medium for melting metals in the ordinary state it is claimed that it is particularly well adapted to melting foundry refuse, slag, grindings, washings, etc., the mechanical puddling effect being of first importance with this class of material.

The burner is set at one end of the revolving drum and the charging and skimming taking place at the

other. Gases are vented from the charging end. The rotating mechanism is set in motion as soon as the metal begins to soften, which should take place 15 or 20 minutes after the flame has been started. When the metal is ready for pouring the current is cut out at a point where the spout has nearly reached the pouring point, the revolution is then completed by the aid of the hand wheel.

Gage Records the Blast Pressure

While many foundries have indicating pressure gages attached to their cupolas, few if any have installed recording pressure gages. For this reason a new pressure recorder put on the market by the Bacharach Industrial Instrument Co., Pittsburgh, has been designed to meet the requirements of simplicity and accuracy. A sectional view of this instrument is shown in the accompanying illustration. Gas or air under pressure is introduced below the bell-shaped float, *T*, through the pipe, *Z*. This float is sealed with water and rises or falls according to the amount of gas pressure under it. The recording mechanism is mounted on top of the tank, *A*, and consists of a drum, *U*, for holding the chart together with a specially designed clock. The standard clock will rotate once in 24 hours so that the record for each day's operation is made complete on one chart. Special clocks with faster or slower speed are supplied if desired. A pen rod, *C*, is rigidly fastened to the float, *T*. The pen which is pivoted at the top of the rod has a cup or reservoir filled with ink for marking the position of the float on a graduated chart. The charts are furnished either 4, 6 or 8 inches high and are graduated to suit any particular requirement. These recording instruments do not require accurate leveling before use.



INSTRUMENT RECORDS BLAST PRESSURE—THE CHART IS MARKED BY THE PEN ATTACHED TO THE FLOAT *T*

Produces Compound For Duplicate Patterns

Where additional patterns in duplicate of the original are desired as an aid to production in the foundry, the Menefee Foundry Co., Fort Wayne, Ind., provides the way by the use of a pattern compound which may be used to produce duplicates without the loss of time and the expense of making metal mounts. It is said that with this compound, patterns requiring weeks to duplicate in metal for use on rollover draw molding machines may be made in the course of but a few hours. The compound is a powder which is mixed with water and poured into a mold made from the original pattern. The pattern is dusted with parting, frames are placed on the drag and cope and the prepared compound is poured. When it has started to set the back plate is screwed to the frame and the pattern is allowed to set. In about 15 hours the new pattern may be removed, washed, brushed and sandpapered. For two days it is left in a warm place, sprinkled each day with water and when thoroughly dry may be coated with shellac to give it a smooth surface.

Several duplicates may be made from one mold if the work is done carefully and thus several machines may be furnished patterns in a short time for quantity production.

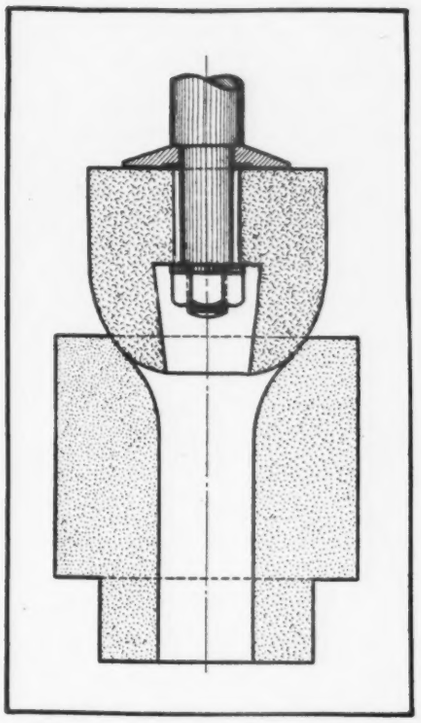
The compound, it is said, gives an exact "casting" of the mold and does not shrink or warp in drying. It has been in actual use in a number of large foundries and thus has been subjected to the test of commercial experience.

Many experiments have been made to find suitable alloys for turbine blades. Aluminum bronze has proved unsuitable as a blade material in the high temperature stages of a turbine, but gives good results in the low temperature stages. This applies only to the ordinary alloys of copper and aluminum that are subject to self-annealing, and not to those ternary alloys scientifically made with a view of eliminating this defect.

DUPLICATE PATTERNS ARE MADE WITH A SPECIAL COMPOUND

Nozzle Grinding Device

Fire clay nozzles used in steel foundries in bottom-pour ladles sometimes become slagged over, destroying the fir of the plug. The stopper must fit perfectly to prevent molten steel from leaking through. It has been found by a number of concerns that grinding wheels may be utilized for grinding the seats in new nozzles and also for grinding out the slag in nozzles which have been used. The Norton Co., Worcester, Mass., makes a wheel with a special attachment for this purpose. The wheel is formed the same shape as the graphite plug and is mounted on a vertical spindle so that it may be fed down into the nozzle which is held stationary. The illustration shows the wheel and nozzle in cross section.



WHEEL FOR GRINDING LADLE NOZZLE SEATS

Foundryman Writes of Cupola Practice

(*Concluded from page* 16)

more than three cars of iron are used in any mixture.

Every morning either the carpenter or machine-shop foreman oils the fan and motor and inspects the fan belts to see that the blowing mechanism is in good condition. Before this was done trouble occasionally was experienced through breakdowns during the heat. On one occasion the blast was off three hours before repairs were completed.

A cupola with a 32-inch inside diameter is handled in much the same way as has been described for charging a 48-inch cupola, the main difference being in the weights of the charges. For a bed two portions of coke weighing 400 and 300 pounds respectively are used. Metal charges weighing 1400 pounds are used, and the coke placed between charges weighs 150 pounds.

American Radiator Co. Buys Plant Site

Six hundred thousand square feet of land along the Boston waterfront have been purchased by the American Radiator Co., on which it is announced it will build a two-story warehouse and factory, covering 95,000 square feet, costing $1,500,000. Other units, giving employment to 2500 to 3000 men, will be added shortly.

Obituary

Myer M. Kann, secretary and treasurer of the Pittsburgh Crushed Steel Co., died at his home in Pittsburgh, Dec. 10. Mr. Kann, who also was president of Harrison Bros., Inc., Amesbury, Mass., and a director of the Specialty Device Co., Cincinnati, and of the National Abrasive Co., Boston, was born in Pittsburgh, Sept. 2, 1857, and made his home in that city throughout his entire life. He was a member of the American Foundrymen's association, the American Society of Mining Engineers, the Pittsburgh chamber of commerce, and several charitable organizations.

An alloy of gold, silver and palladium, for dental use consists of palladium, 15 parts; gold, 50 parts and silver, 35 parts.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Erection of a foundry building is contemplated by the Sawyer Brass & Iron Foundry, Oswego, N. Y.

The Buda Motor Co., Harvey, Ill., contemplates the erection of a foundry, 140 x 160 feet.

The Flint Foundry Co., Flint, Mich., has taken over the plant of the Marshall Foundry Co.

The Production Foundries Co., Ann Arbor, Mich., has increased its capital from $100,000 to $350,000.

The Wilson Stove Co., Metropolis, Ill., will build a plant, 100 x 120 feet.

Fred Menagh, 101 Pintey street, Ottawa, Ont., has started work on the erection of a foundry.

The Flint Pattern & Foundry Co., Flint, Mich., will build a plant, 40 x 100 feet.

The Yates & Johnson Co., Chippewa Falls, Wis., is erecting a foundry and machine shop, 125 x 200 feet.

Erection of a plant addition is contemplated by the West Bend Aluminum Co., West Bend, Wis.

Plans have been prepared for the erection of an office building for the Western Foundry Co., Chicago.

The Tarrant Foundry Co., 369 West Grand avenue, Chicago, contemplates the erection of a storage building.

The Waterloo Gas Engine Co., Moline, Ill., has had plans prepared for the erection of a plant to include a main factory building, 100 x 160 feet, and a core building, 120 x 140 feet.

Capitalized at $15,000, the Consolidated Antique Brass Works, Inc., New York, recently was incorporated by D. Ripp, L. Hoffman and D. Klein, 84 Avenue D.

Plans have been drawn for the erection of an addition to the foundry of the Galusha Stove Co., Rochester, N. Y. The building will be 37 x 96 feet.

A permit has been taken out by the American Stove Co., Cleveland, to erect an addition to its plant, 60 x 152 feet.

An increase in capital from $400,000 to $600,000, recently was made by the West Michigan Steel Foundry Co., Muskegon, Mich.

Plans have been prepared for the erection of a plant, 50 x 144 feet, for the Rock Island Stove Co., Rock Island, Ill.

Work has started on the erection of a foundry, 100 x 300 feet, for the American Foundry & Equipment Co., 2931 West Forty-seventh street, Chicago.

The William J. Mills Brass Works, Brooklyn, N. Y., recently increased its capital stock from $2000 to $10,000.

Capitalized at $10,000, the Nutmeg Crucible Steel Co., Branford, Conn., has been incorporated to make steel and iron castings, fittings, etc., by Charles Reynolds, Ernest V. Peterson and Augustus Halliden.

The Boicourt Co., 1001 Railroad avenue, Ft. Worth, Tex., is installing an iron foundry. J. L. Boicourt controls the company.

Capitalized at $25,000, the Imlay City Foundry Co., Imlay City, Mich., recently was incorporated by Herman A. Chriscinske, P. W. Mulder and Will Borland.

The American Road Machinery Co., Bay City, Mich., will erect a plant, 50 x 200 feet, which will include a foundry.

Plans have been prepared for the erection of a plant, 30 x 100 feet, for the Hudson Brass Works, Ogdensburg, N. Y.

Capitalized at $10,000, the Hartford Foundry Co., Hartford, Wis., recently was incorporated by I. L. Bonniwell, R. LaPoint and others.

Erection of an addition to its foundry, 80 x 80 feet, is reported being contemplated by the Griffin Foundry & Mfg. Co., Rome, Ga.

The Taylor & Fenn Co., Hartford, Conn., machine tools and iron castings, recently increased its capital stock from $250,000 to $375,000.

The Crane Co., Chicago, has awarded a contract to Stone & Webster, New York, to erect a combined

manufacturing and foundry building at Bridgeport, Conn. The building will be 3-stories, 80 x 500 feet.

The Ross-Meehan Foundries, Chattanooga, Tenn., contemplates the erection of an addition to its plant.

The Smith Iron Foundry Co., 31 Marshall wharf, Lynn, Mass., contemplates the erection of a plant addition.

Fire recently damaged the foundry owned by Frank D. Lane, Orchard and Howard streets, Franklin, Pa. It will be rebuilt.

The Manufacturers' Foundry Co., Fifteenth and Oklahoma avenues, Milwaukee, contemplates important enlargement of its gray iron and malleable shop in 1920.

Capitalized at $25,000, the Federal Foundry Co., Canton, O., has been incorporated by Clarence M. Converse, L. A. Converse, Frank A. Peter, A. M. Peter and Russel J. Burt.

A site has been obtained at Vassar, Mich., for the J. C. Green Foundry Co. The building, which will be erected, will be 60 x 160 feet. J. C. Green is president of the company.

The Lake Erie Foundry Co., Painesville, O., recently was incorporated with $50,000 capital, by H. K. Wade, L. H. De Forest, Maude C. Price, Fred M. Wyss and C. A. Newport.

The Crompton & Knowles Loom Works, Worcester, Mass., has let a contract for the erection of a 2-story, 73 x 98-foot building, to be used for the storage of castings.

The Bedford Iron & Steel Works, Bedford, Va., recently incorporated will erect a foundry and a machine shop, according to a report. J. J. Scott is president of the company.

The Springfield Aluminum Plate & Castings Co., Springfield, O., has been incorporated to manufacture vibrator plates, and a new plant is to be built. William Jordan, E. A. Parker and Frank Hook are interested.

The DeHart & Chilton Machine & Foundry Co., Nashville, Tenn., has applied for a charter. The company has a capitalization of $50,000 and was organized by S. K. DeHart, H. L. Beaty, B. B. Cranch and others.

The Pelton Steel Co., Milwaukee, is erecting an addition, 30 x 100 feet, to its electric steel foundry.

The Avery Co., Peoria, Ill., is erecting an addition to its engine works at West Allis, Milwaukee. James Pinson is general manager.

The Liberty Auto Lock Co., St. Louis, has been organized with offices at 2209 Pine street, by E. W. Link, John L. Malone and others, to engage in the manufacture of locks, etc. The company plans to erect a plant, which will include a foundry.

The Mascot Stove Mfg. Co., Chattanooga, Tenn., has obtained a lease on the old foundry of the American Brake Shoe & Foundry Co. and will remodel the plant into a modern stove foundry. The plant is expected to be put into operation by Feb. 1.

Manning, Maxwell & Moore, New York, owner of the Shaw Crane Works, Muskegon, Mich., is reported planning to build a plant at Muskegon, for the manufacture of machine tools and gas engines, which will include a foundry.

The Western Wheel & Foundries, Ltd., St. Boniface, Man., recently was incorporated to manufacture car wheels, etc., with $2,000,000 capital, by John A. McVicar, Albert T. Hawley, Norman J. D'Arcy and others of Winnipeg. The company is now building a plant.

The Frost Mfg. Co., Kenosha, Wis., manufacturer of brass goods and general plumbing and steam heating supplies, has awarded contracts for the erection of two plant additions, each 66 x 76 feet, to its brass foundry and machine shop. New equipment is being purchased.

An increase in capital, from $50,000 to $100,000, recently was made by the Cummins Engine Co., Columbus, Ind., manufacturer of oil engines, to finance the purchase of additional equipment necessary for the carrying on of a larger business. The increase in business has caused the installation of $15,000 additional equipment, most of which has been purchased. C. L. Cummins is president.

Chattanooga, Tenn., has been selected as the location for the southern branch of the Somerville Iron Works, Somerville, N. J. Work upon the plant, representing an investment of $1,500,000, will be started at once. Cast iron soil pipe will be manufactured exclusively, and the plant will have a capacity of 50,000 tons of pipe annually. The Austin Co., Cleveland, has the contracts to erect the buildings.

The gray iron foundry of the former Janesville Machine Co., Janesville, Wis., now a part of the Samson Tractor Co., will be enlarged by the erection of an addition, 120 x 180 feet. The present foundry and machine shop are being remodeled and re-equipped for the manufacture of a passenger car and a farm motor truck, which the Samson company will build for marketing with its tractors and power farm machinery.

The National Malleable Castings Co. has awarded contracts for the erection of a building, 108 x 302 feet, as an addition to its plant at Sharon, Pa. This building will be used in the manufacture of steel anchor chains, and replaces an old structure. The manufacture of anchor chains by the company is now carried at its Cleveland plant, but when this structure is completed, it is the intention of the company to transfer this business from Cleveland.

Contracts have been closed by the Chicago Malleable Castings Co., 120th street and South Racine avenue, West Pullman, Chicago, for the erection of a large plant addition, which when completed is expected to increase the plant's output about 40 per cent. Orders for practically all the necessary equipment, including tumbling barrels, core ovens and molding machines, have been placed. The addition is expected to be ready for occupation by Feb. 1.

The Eastern Foundry Co. which operates a gray iron plant at Jamesburg, N. J., for casting piano plates and backs, as well as other castings for musical instruments, recently was incorporated with $350,000 capital. The incorporators include, Thomas J. Watts, Mattawan, and William B. White, South River, N. J. The office of the company is at 152 Main street, South River, where the company is about to erect a branch plant, to contain 40,000 square feet of floor space.

Capitalized at $100,000, the Pacific Iron & Steel Co., Inc., 610 Lauchlin building, Los Angeles, will equip a foundry and machine shop in addition to its present steel plant. Construction will start soon on these two buildings, and the company will be in the market for foundry and machine shop equipment. Officers are: President, D. M. Ward; vice president, A. J. Anderson; secretary and treasurer, C. E. Bradburn. The plant is located at 2637-2665 Humboldt street, Los Angeles.

Incorporated under the laws of Michigan with $40,000 capital, the Hasse-Cline Pattern & Mfg. Co., 110 St. Antoine street, Detroit, has taken over by purchase the Main Pattern Shop, Inc., 25 East Fort street, Detroit, and the Detroit Pattern Works, 108-110 St. Antoine street, Detroit. Both plants are equipped to handle anything in the pattern line with the exception of stove patterns. Officers of the company are: President, William F. Haase; vice president, R. D. Johnston; treasurer, C. L. Cline, and secretary, B. F. Guertler.

Work has been started at Auburn, R. I., on additions to the present foundry of the Universal Winding Co. The building when completed will be 150 x 479 feet and will have a capacity for melting 50 tons daily. The equipment will be the most modern obtainable and will be adaptable to all foundry purposes. The present construction includes a building, 159 x 200 feet, on the north end of the present foundry of frame construction, and a building, 50 x 159 feet, on the south end, which will be of brick, and two-stories. In addition to this an office building, 25 x 50 feet, will be built.

Work has been started on the erection of a machine shop, 60 x 400 feet, for the Arctic Ice Machine Co., Canton, O., and the company expects to start work shortly on the erection of an erecting shop, 140 x 400 feet, which will have one main bay 60 feet wide, running through the center, served by two 15-ton cranes, while the two side bays will be equipped with small tools. The company later will erect a foundry for the manufacture of gray iron and semi-steel castings. This building will contain between 30,000 and 40,000 square feet of floor space. All tool equipment for the machine shop has been ordered, but the tools and cranes for the erecting shop will not be purchased until April or May, while contracts for the foundry equipment will not be let until July. The company also plans to improve its power plant. H. D. Pownall is president and general manager.

Plans have been prepared for the erection of a foundry, 120 x 220 feet, for the Buckeye Traction Ditcher Co., Findlay, O. The center bay of the structure will be equipped with 5-ton traveling cranes, while the two side bays will be equipped for light molding. The company plans to install its present melting equipment, consisting of a cupola for gray iron and a 1-ton electric furnace for steel castings. In addition the company will install a 500-pound brass melting furnace of improved design, melting the brass without crucibles. Both cupola and the electric furnace will be served from the same charging platform. Due to the fact the company at present has a fully equipped foundry, it will not be in much need of new equipment, but later will be in the market for molding machines. The new foundry when completed, will have two and a half times the capacity of the present foundry. L. A. Krupp is superintendent.

New Trade Publications

SAND-BLASTING.—The W. W. Sly Mfg. Co., Cleveland, has published the November issue of its pamphlet, and in it a description of a "baby" sand-blast barrel is given.

NEW CONSTRUCTION.—Westinghouse, Church, Kerr & Co., New York, is circulating an illustrated folder, entitled "Shops," in which views of a number of plants it has erected are given.

METAL HOSE.—The United Metal Hose Co., Inc., New York, is circulating a 4-page cardboard circular in which two kinds of flexible metal hose are described and illustrated. Specifications, etc., are given.

HOT-BLAST HEATER.—Robert Gordon, Inc., Chicago, has published an 8-page booklet in which a mechanical hot-blast heater is described and illustrated. This heater is designed for use in heating large or small buildings, foundries of all sizes, factories, garages, temporary buildings, schools, etc., and can be used for drying clay products, asbestos, magnesia, textiles and other products dried by warm air up to a temperature of 400 degrees Fahr.

HEAT INSULATIONS.—The Franklin Mfg. Co., Franklin, Pa., is circulating a large booklet, containing a large number of illustrations, in which pipe covering such as magnesia, asbestos, etc., are described. The first part of the booklet is devoted to a description of the company's products. The second part to sales data and a third section acts as a reference department, and contains much valuable information to purchasers of this material. The booklet should be of interest.

OPEN-HEARTH FURNACE.—An 18-page booklet has been prepared by the McLain-Carter Furnace Co., Milwaukee, in which open-hearth furnaces are described and illustrated. These furnaces are designed for both acid and basic melting and a complete unit consists of a hearth, uptake flues, checker chambers, reversing valve, stack and charging floor. The hearth is built upon heavy cast iron plates supported on structural I-beams and the walls and roof are securely held in place by structural I-beam buck stays. The door frames are made in sections and may be easily moved. Other details are given and the illustrations show various features of the furnaces.